

**Preliminary
Review of Spatial Density of Ambient Toxic Monitors
and Implications on
Trends and Exposure Variability (outdoor)
using Motor Vehicle, Point Source, and Global Background
Pollutants**

**State, Regional, City, and Neighborhood Monitors
A Case Study in California**

**Monitoring and Laboratory Division
CA Air Resources Board
June, 2002**

Objectives



- Why program established- goals, evolution
- Today's toxics monitoring
- How data are used
- What can we learn about monitoring from inter-site variation and trends
- Issues facing us

California Law

- Required ARB to identify and regulate air toxic emissions
- Risk Assessment
 - Monitoring gases and metals began in 1985
 - Develop exposure component
 - Augmented by CAA HAPS, pesticides
- Risk Management
 - Develop air toxic control measures
 - Controls to date

Why program established- goals, evolution

Field, Lab, and QA Changes

- **Sites added and discontinued**
 - feedback loop
- **Methods developed**
 - gases, hex chrome
 - gas and particle samplers
- **Methods modified**
 - single v. multiple analyses methods
- **Method changed**
 - GC to GC/MS (gases),
 - XRF to ICPMS (some metals)
- **LODs lowered**
- **Sampling media changed**

Why program established- goals, evolution

QA/QC: ARB

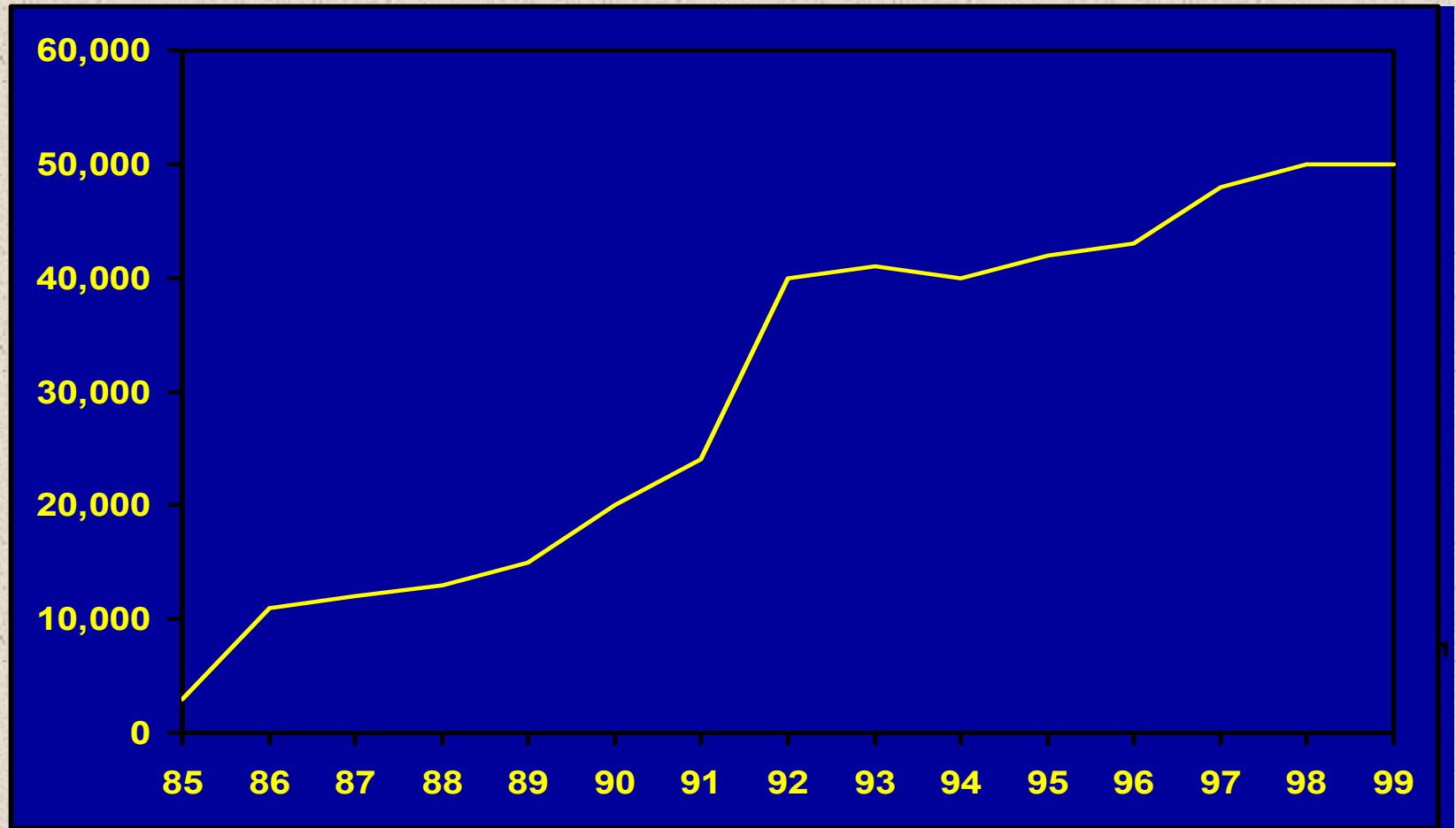
- Calibration : NIST ambient level primary standards
- Lab Audits : NIST primary standards
- Thru-the Probe Audits : NIST primary standards
- QA Manual; QC reports
- Whole-Air Sample Inter-lab Comparison
- Parallel operation with Bay Area AQMD
- Collocated sampler sites

Why program established- goals, evolution

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- Lessons/Issues

Number of Toxic Air Contaminants Reported 1985 - 2000



Today's toxics monitoring

Compounds Measured

- Metals , PaH, dioxin, furans, PCB, PBDE, pesticides
- Gases

Dichloromethane

Chloroform

Ethylene Dichloride

1,1,1-Trichloroethane

Carbon Tetrachloride

Trichloroethylene

Ethylene Dibromide

Perchloroethylene

1,3-Butadiene

Carbonyls (formaldehyde, acetaldehyde, MEK)

Benzene

Toluene

Ethyl Benzene

Xylenes

Chlorobenzene

Styrene

Dichlorobenzenes

Methyl-*t*-butyl Ether

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California air toxics law requires:

“...the state board (ARB) shall give **priority to the evaluation and regulation of substances based on factors related to.... and **ambient concentration** on the community.”**

“.....the risk of harm to public health, amount or potential amount of emissions, manner of, and exposure to, usage of the substance in California, persistence in the atmosphere, and ambient concentrations in the community”

[View a Different Site](#)[View a Different Substance](#)[Order a Data CD](#)

Annual Toxics Summary

Burbank-W Palm Avenue**Benzene**

parts per billion

Year	Months Present	Minimum	Median	Mean	90th Percentile	Maximum	Standard Deviation	Number of Observations	Detection Limit	Estimated Risk
2000	12	0.4	1.1	1.27	2.6	3.0	0.75	29	0.2	117
1999	12	0.1	1.3	1.64	3.3	4.4	1.12	29	0.2	151
1998	12	0.1	1.4	1.66	3.1	4.0	0.93	29	0.2	154
1997	12	0.5	1.4	1.48	2.9	3.9	0.93	30	0.2	137
1996	12	0.25	1.8	1.91	2.8	7.4	1.26	30	0.5	177
1995	12	0.25	2.3	2.45	3.7	6.7	1.43	31	0.5	227
1994	12	0.25	3.2	3.33	4.8	7.7	1.61	29	0.5	308
1993	12	0.25	2.2	2.63	4.5	5.5	1.33	33	0.5	244
1992	12	1.0	3.2	3.44	5.6	6.3	1.45	30	0.5	319
1991	12	0.25	3.4	3.91	7.5	8.4	2.37	29	0.5	362
1990	12	2.0	3.9	4.79	8.4	10	2.32	31	0.5	444
1989	12	1.7	4.8		10.9	11	3.13	12	0.5	

Notes: Values below the Limit of Detection (LoD) assumed to be % LoD.

Means and risks shown only for years with data in all 12 months.

Risks shown only for those substances with [unit risk factors](#).

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Analyses Matrix

	Benzene	Perchloroethylene	Carbon Tetrachloride	Hexavalent Chromium
	MV	Point	Global	Point
Statewide			X	X
	X	X		
Regional		X	X	X
	X	X		
City/Neighborhood			X	X
	Variability			X

inter-site variation and trends

	Statewide (tons/year)	Motor Vehicle (percent of total)	Area Source	Stationary Source
Benzene	22,000	82	12	6
Carbon Tetrachloride	4.7	0	0	100
Hexavalent Chromium	2.2	*41	0	51
Perchloroethylene	12,000	0	18	82

* trains, ships

Source: ARB Almanac 2002

inter-site variation and trends

Air toxic network data used

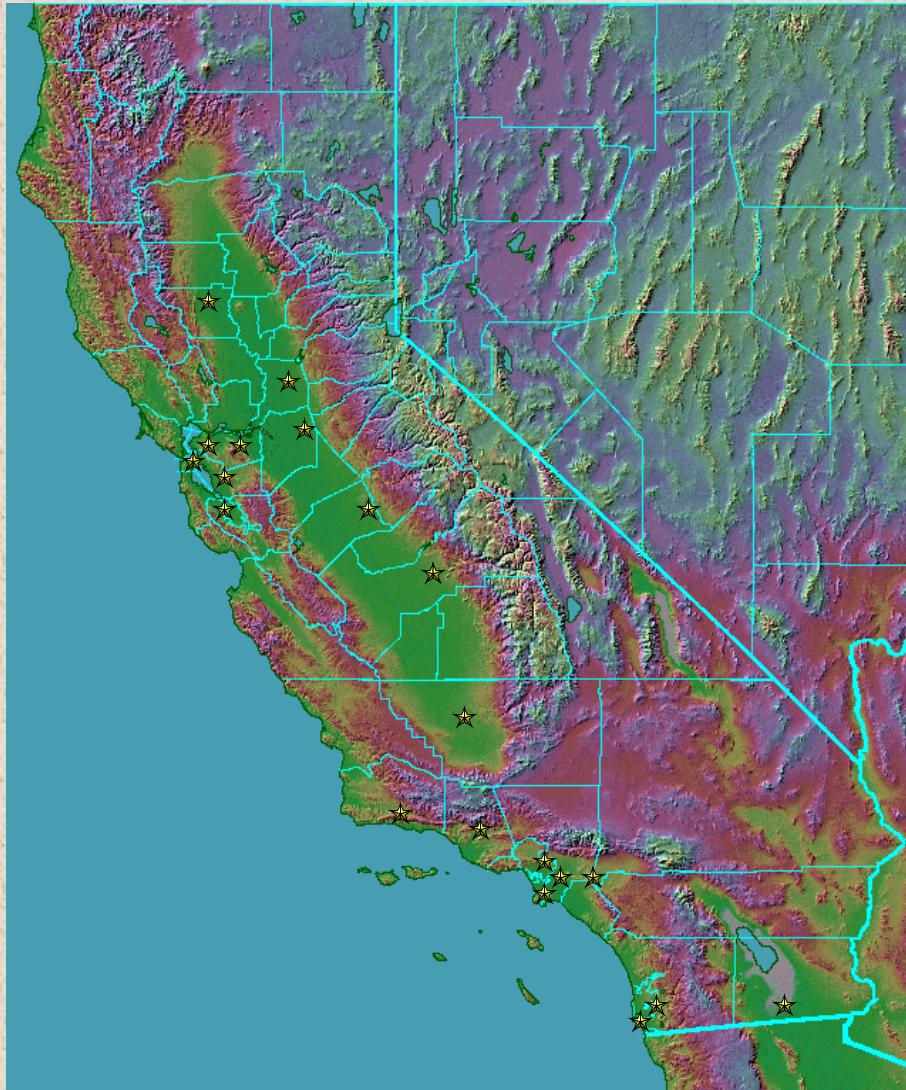
ARB Toxics

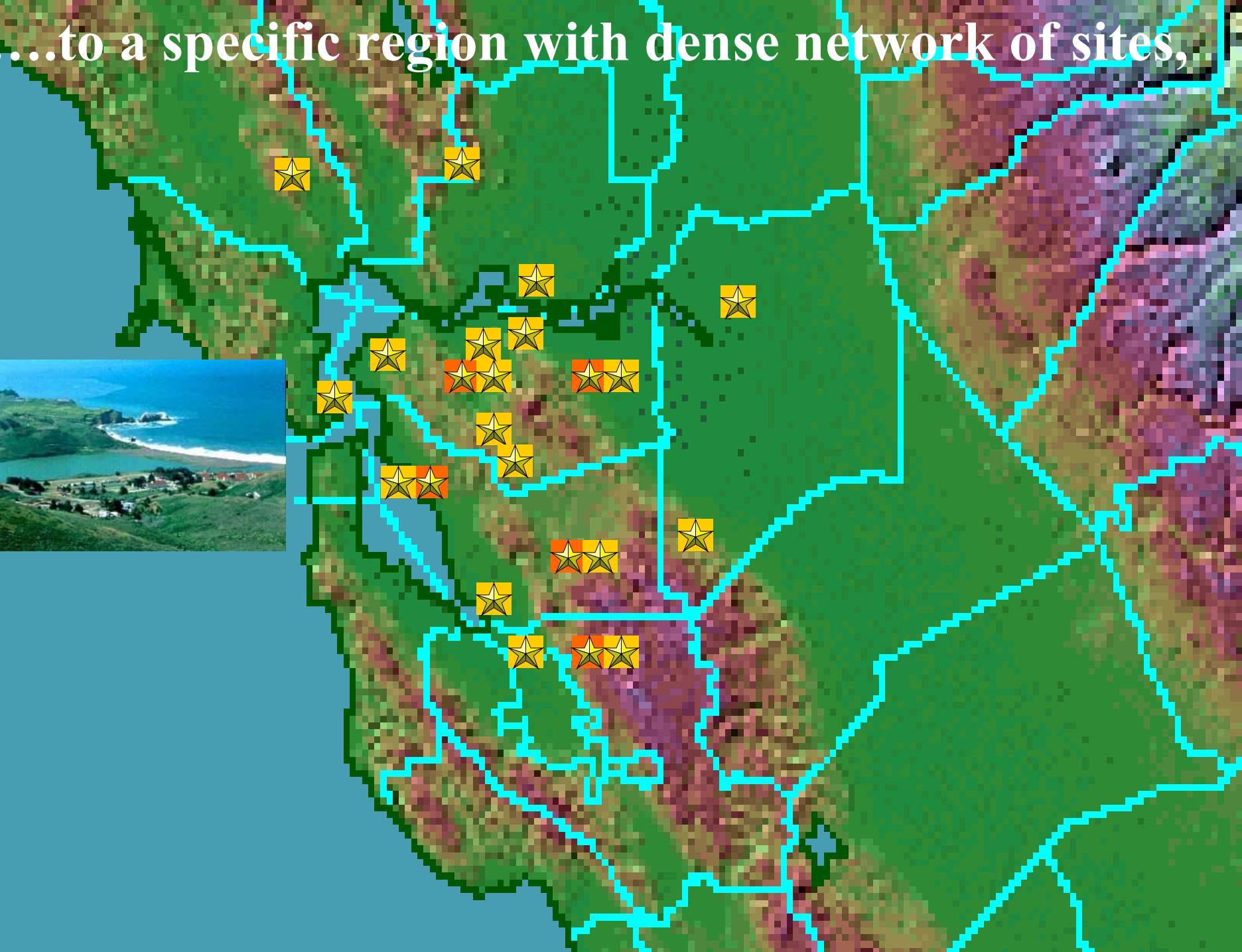
- ~20 sites in 5 Regions in California
- Gases
 - Sampling:
 - 1 in 12 day
 - 24 hr
 - Canister
- Lab/TTP/Whole Air
Parallel with BAAQMD
- Metals

Bay Area AQMD Toxics

- ~20 Sites in Bay Area
- Gases
 - Sampling:
 - 1 in 12 day
 - 24 hr
 - Canister
- Lab/TTP/Whole Air
Parallel with ARB

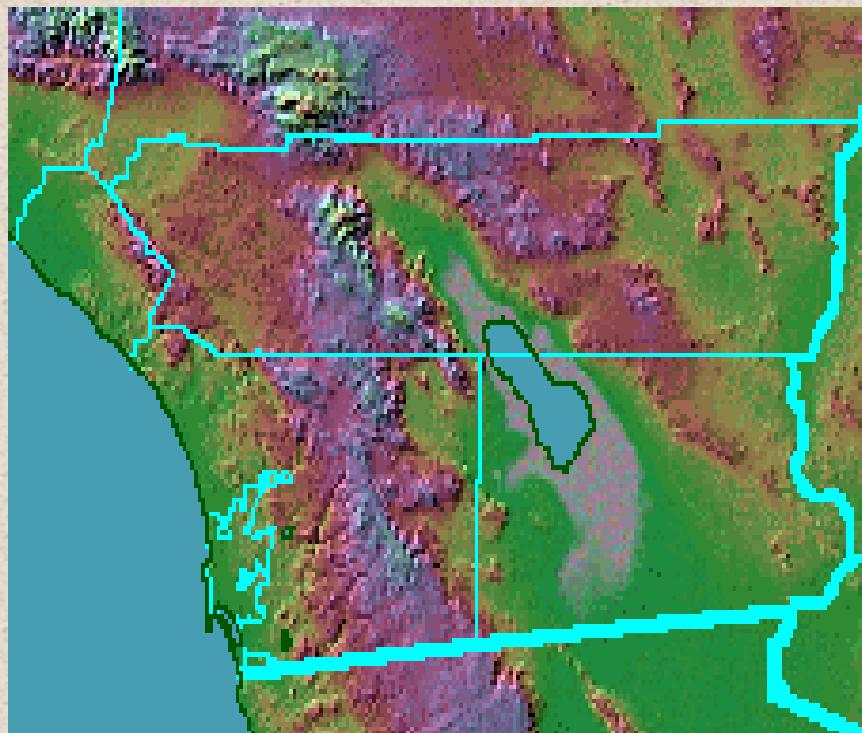
From a statewide perspective





...to a specific region with dense network of sites,

....to a neighborhood.



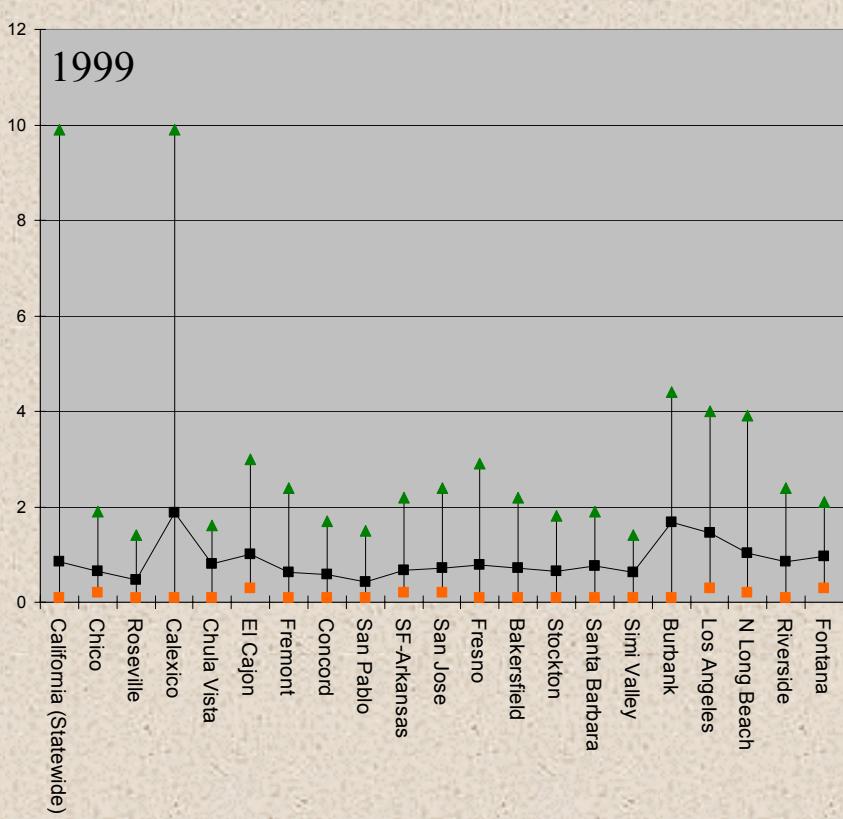
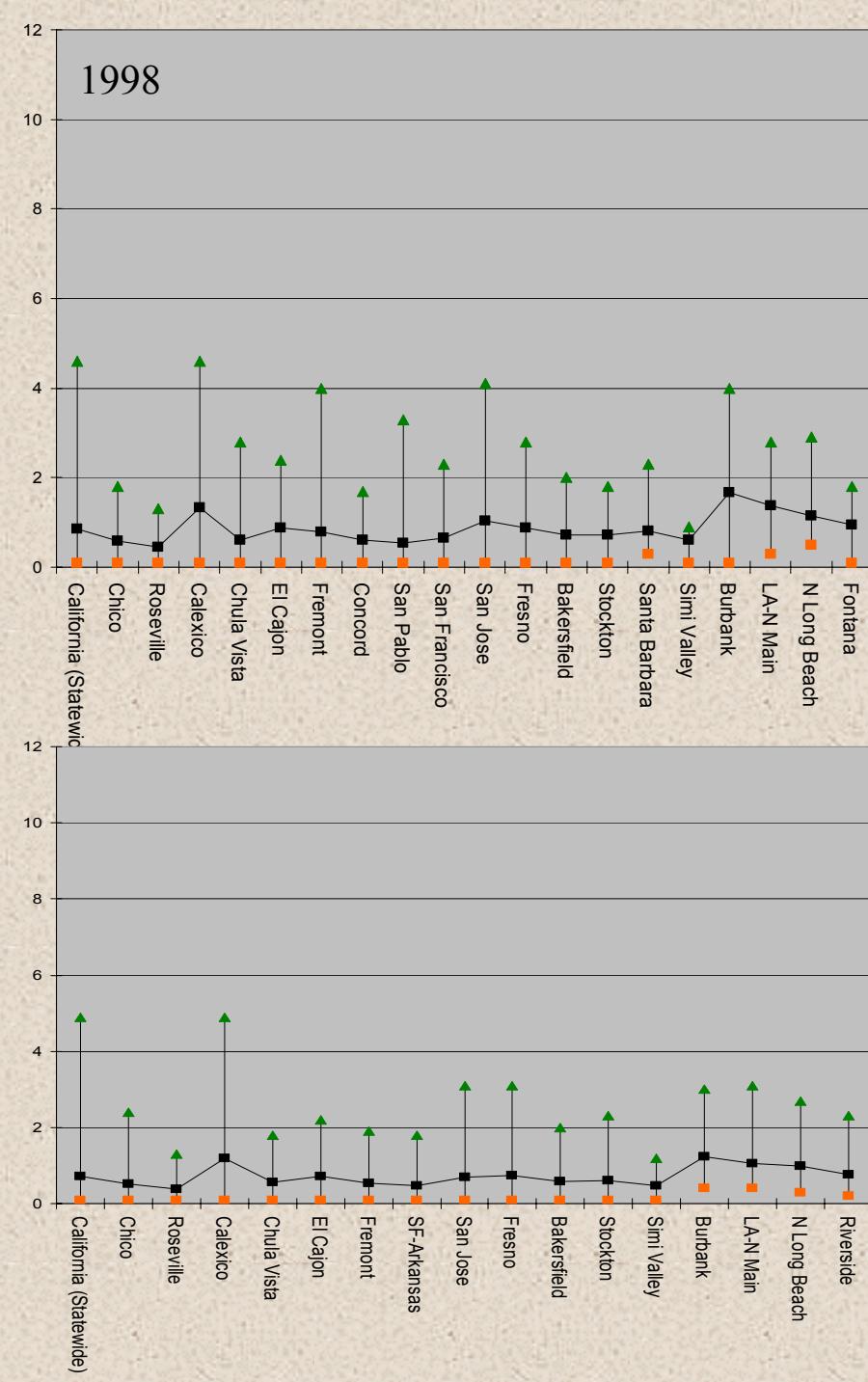
**Barrio Logan/
San Diego**

Metrics Used

- Variabilty
 - Statewide / Regional
 - Annual average, maximum, minimum
- Trends
 - Statewide / Regional
 - Trends (2 Year Moving Means)

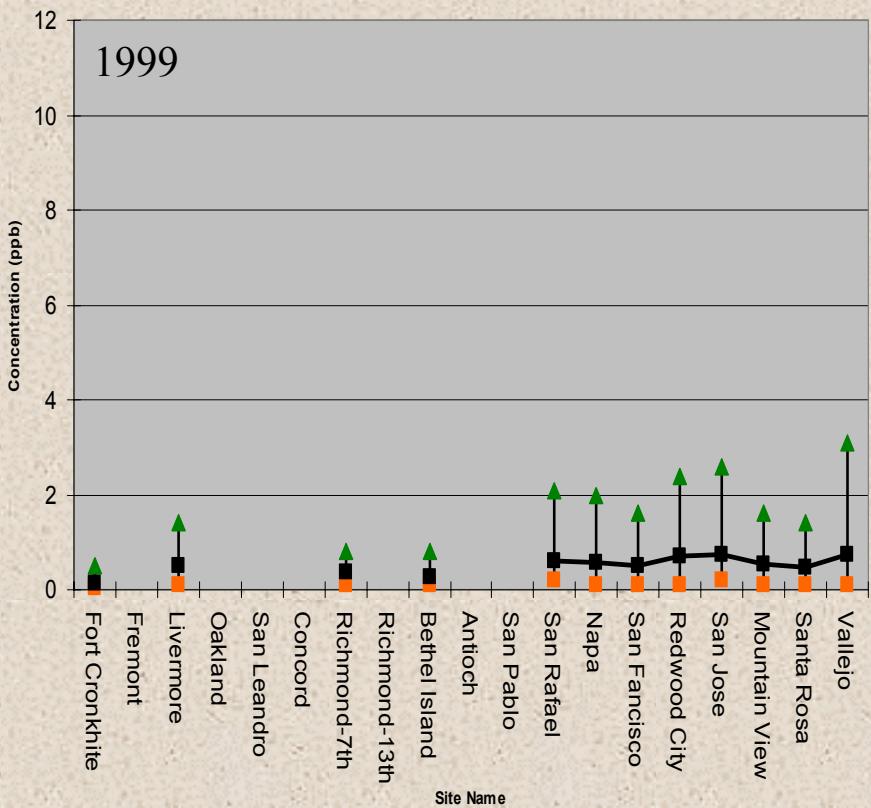
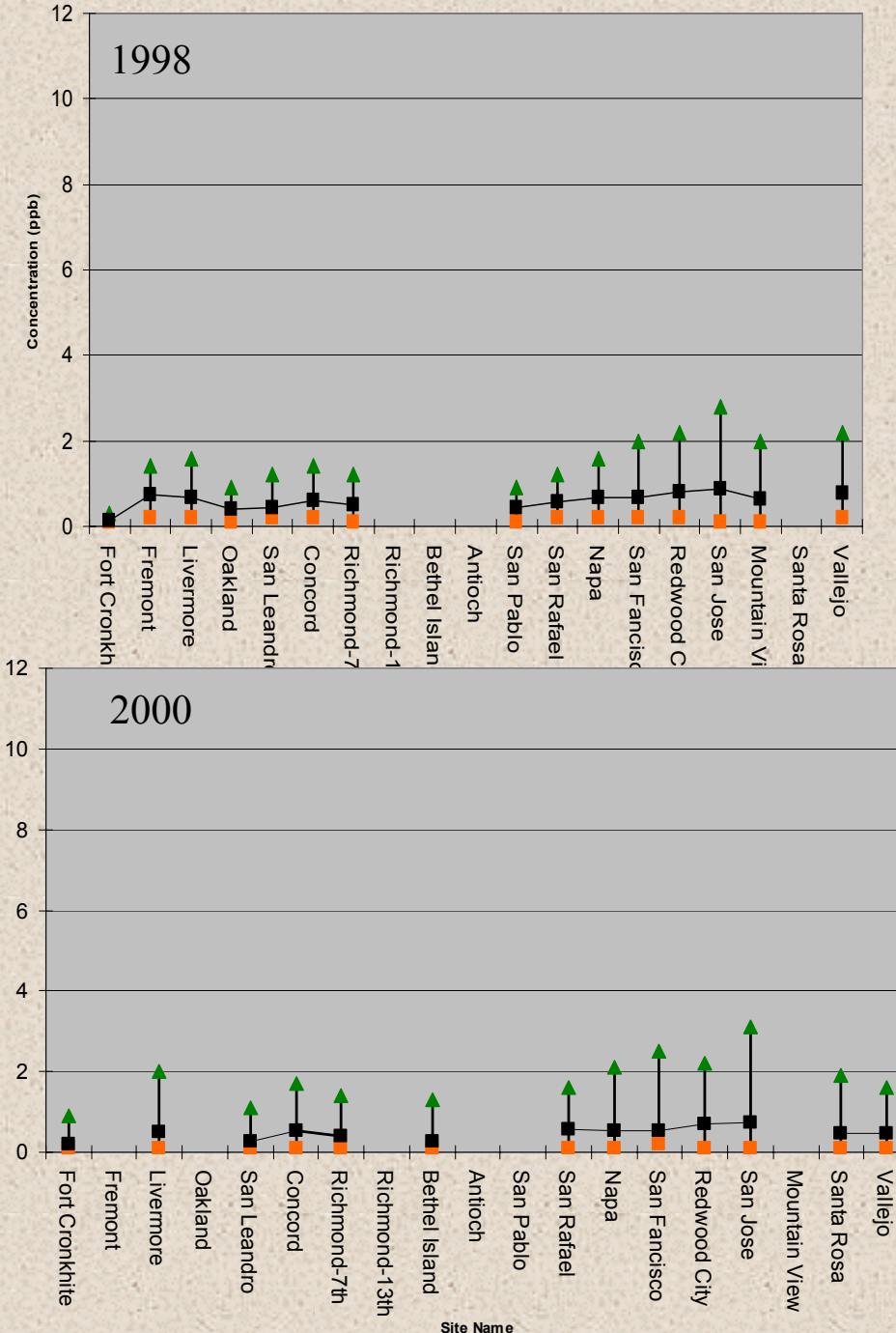
Benzene

inter-site variation and trends



Ambient Benzene Intersite Variability *Statewide Sites 1998-00*

Max/Mean/Min

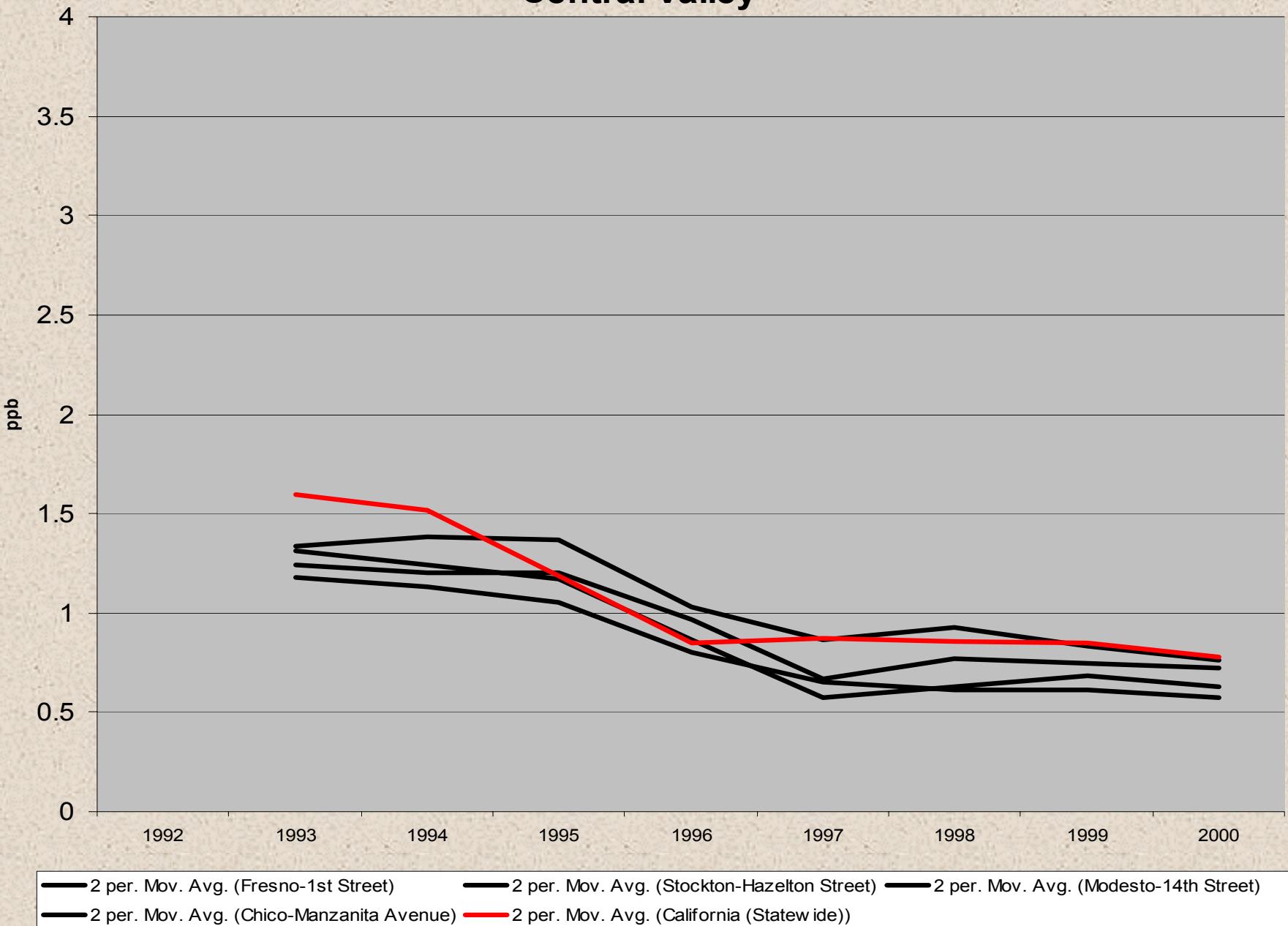


Ambient Benzene Intersite Variability

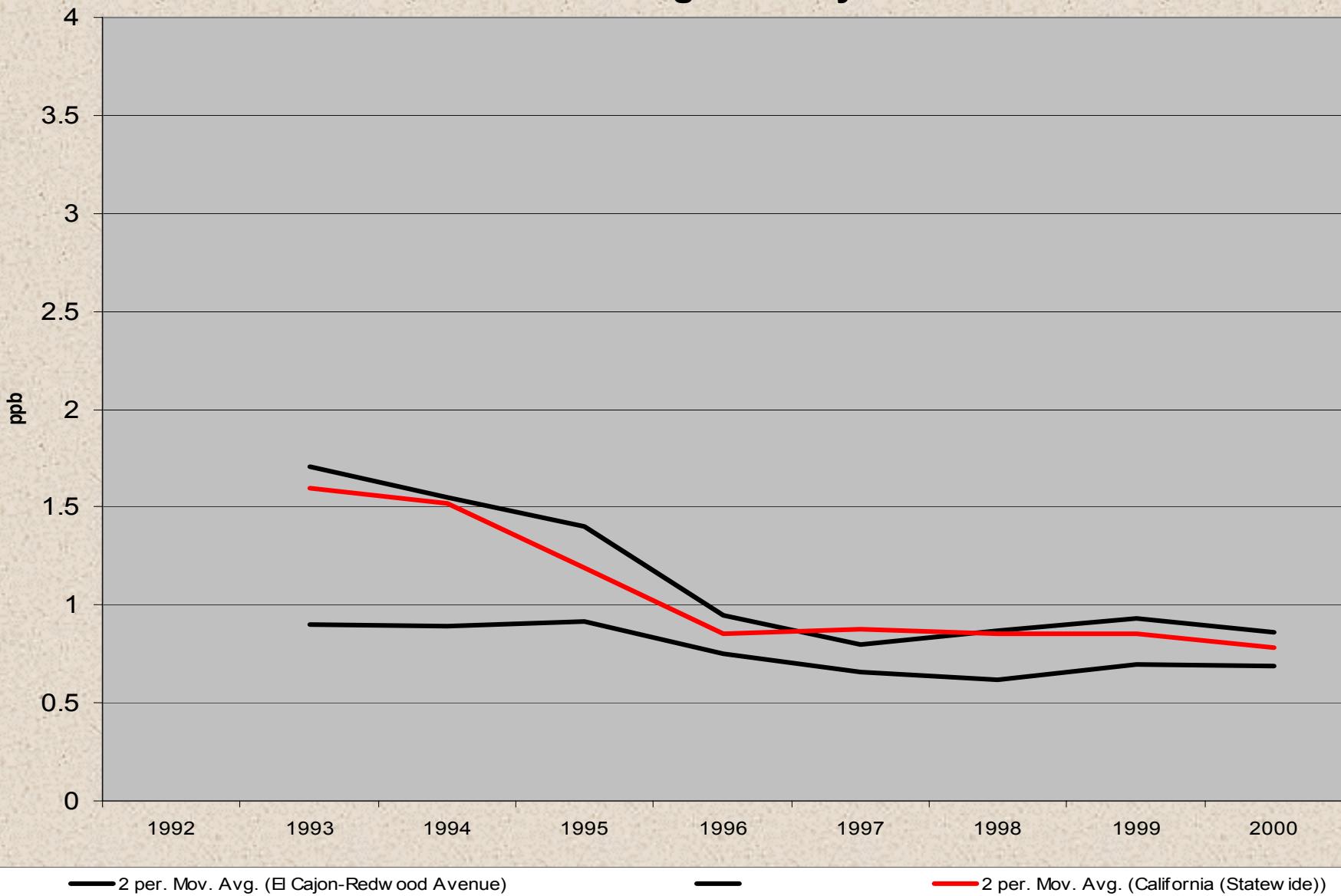
Regional Sites 1998 and 2000

Max/Mean/Min (SF Bay Area)

2 Yr Moving Average Benzene Central Valley



2 Yr Moving Average Benzene San Diego County

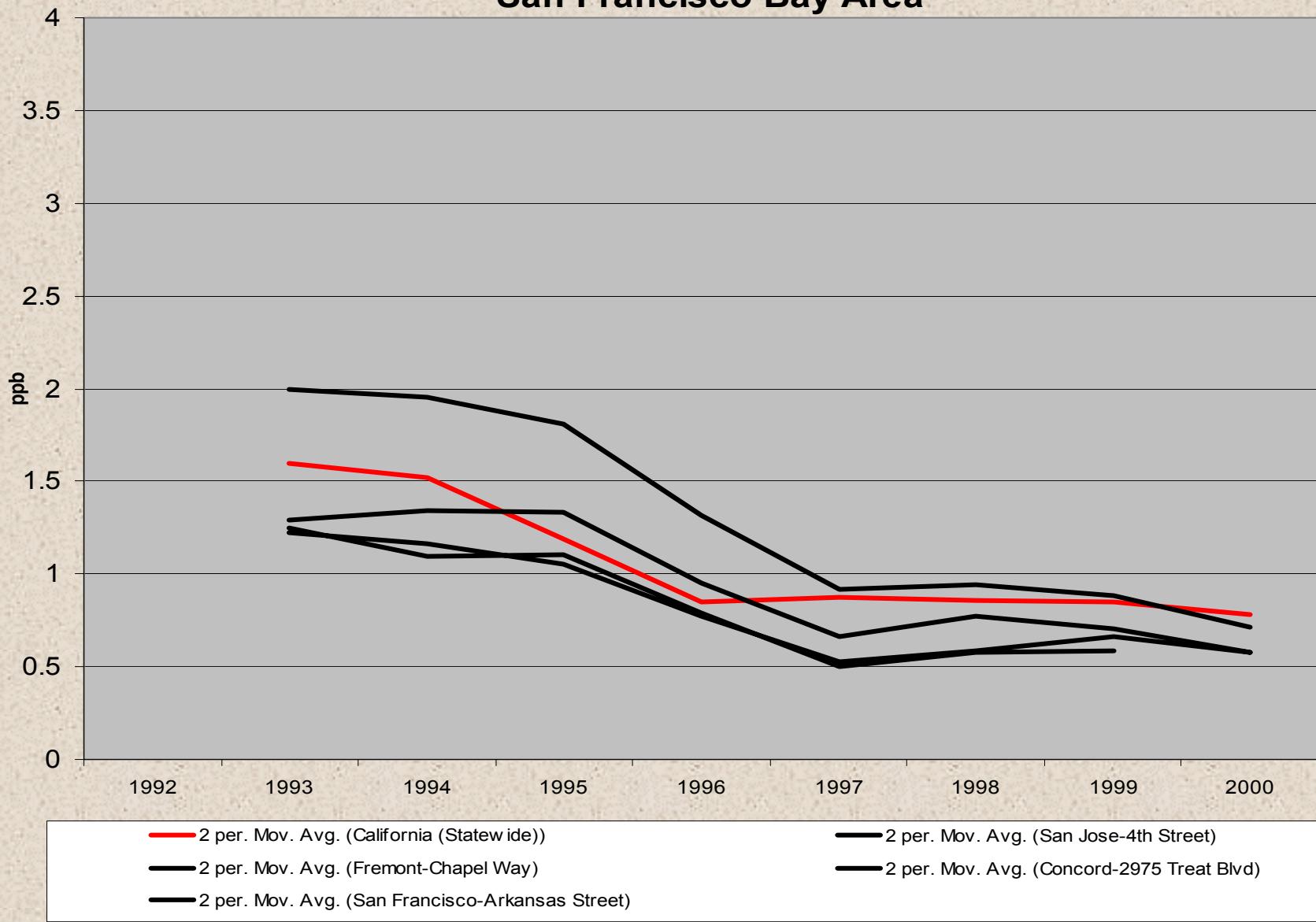


— 2 per. Mov. Avg. (Cajon-Redwood Avenue)

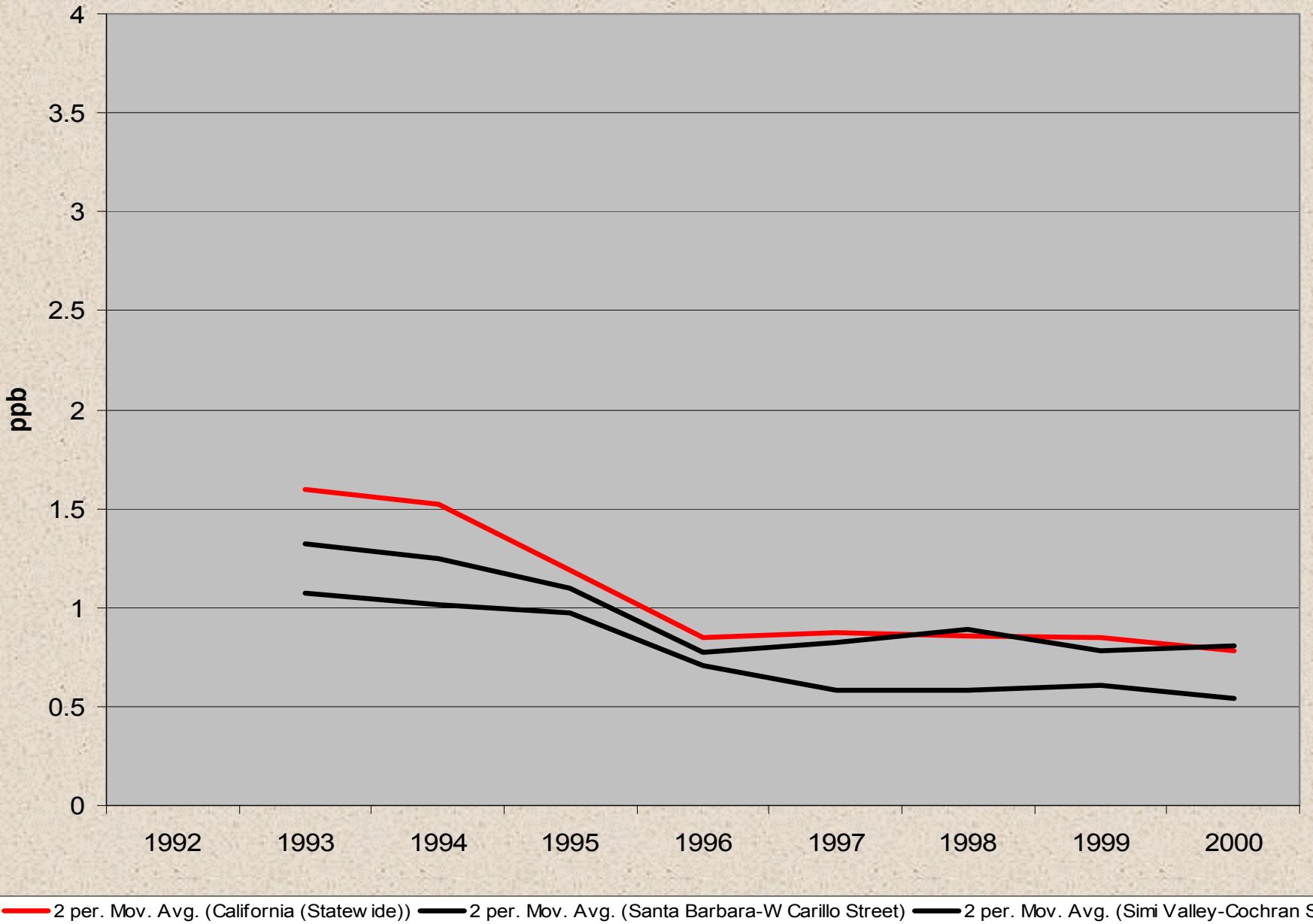
—

— 2 per. Mov. Avg. (California (Statewide))

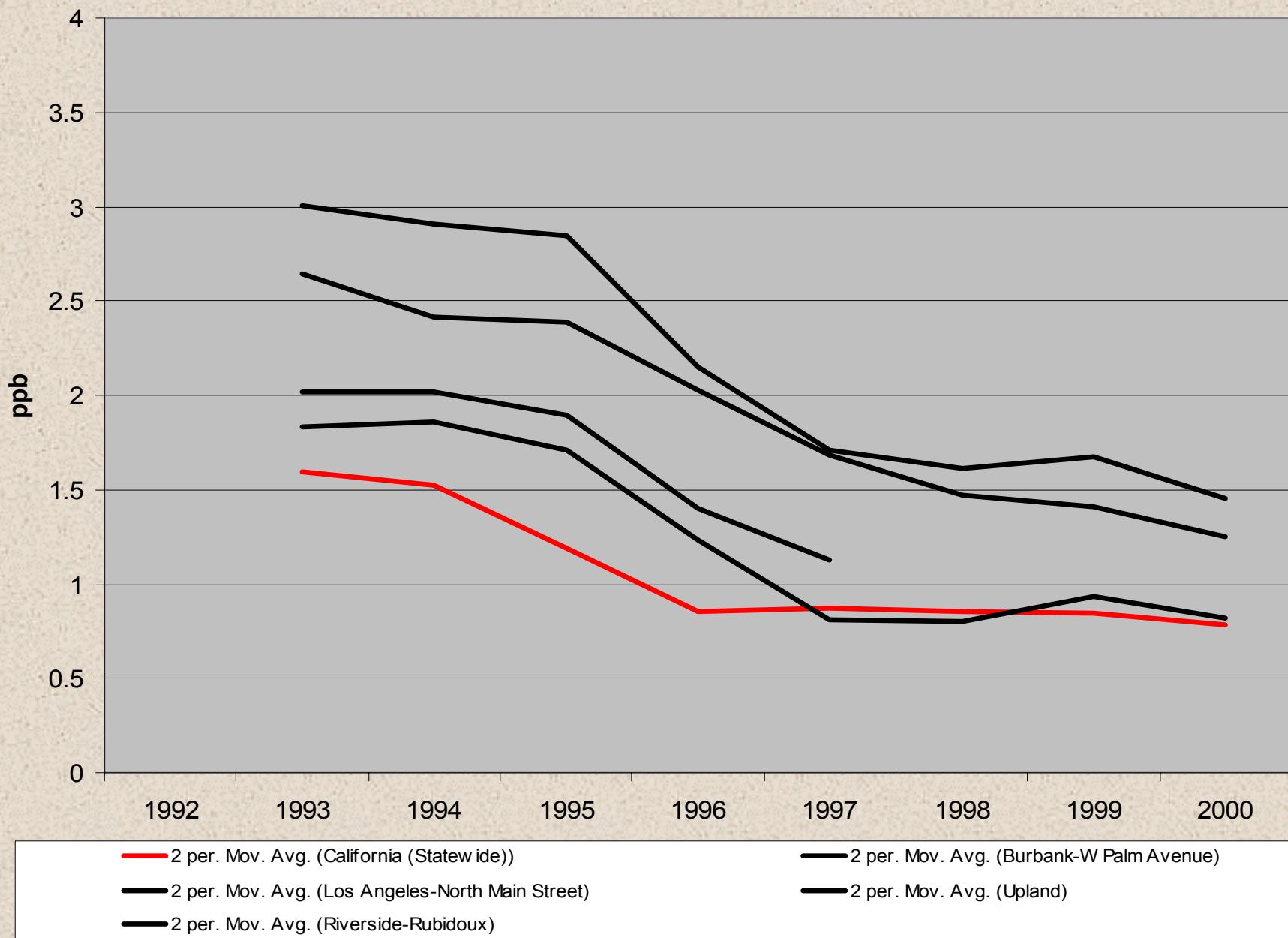
2 Yr Moving Average Benzene San Francisco Bay Area



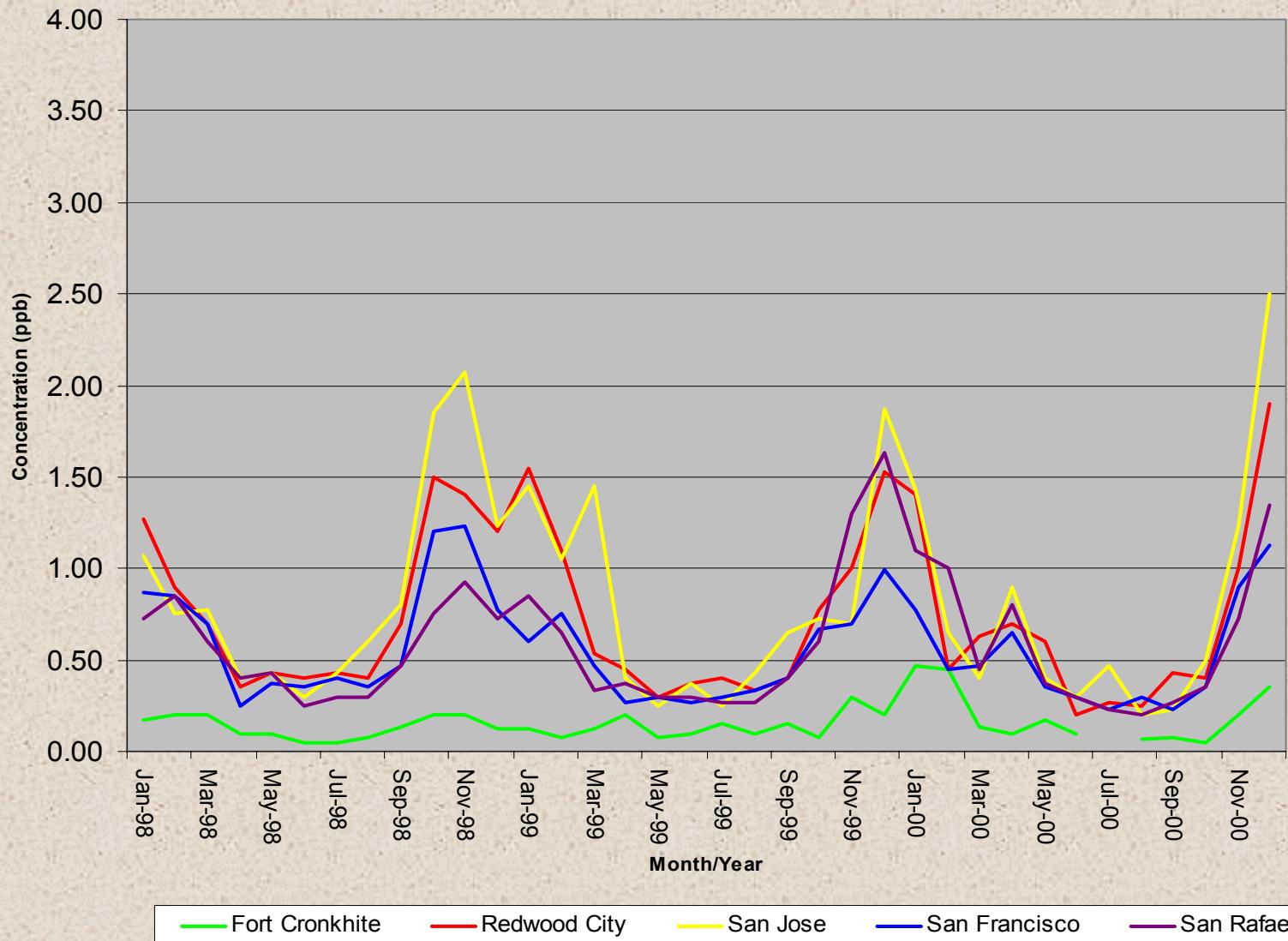
2 Yr Moving Average Benzene South Central Coast



2 Yr Moving Average Benzene South Coast Air Basin



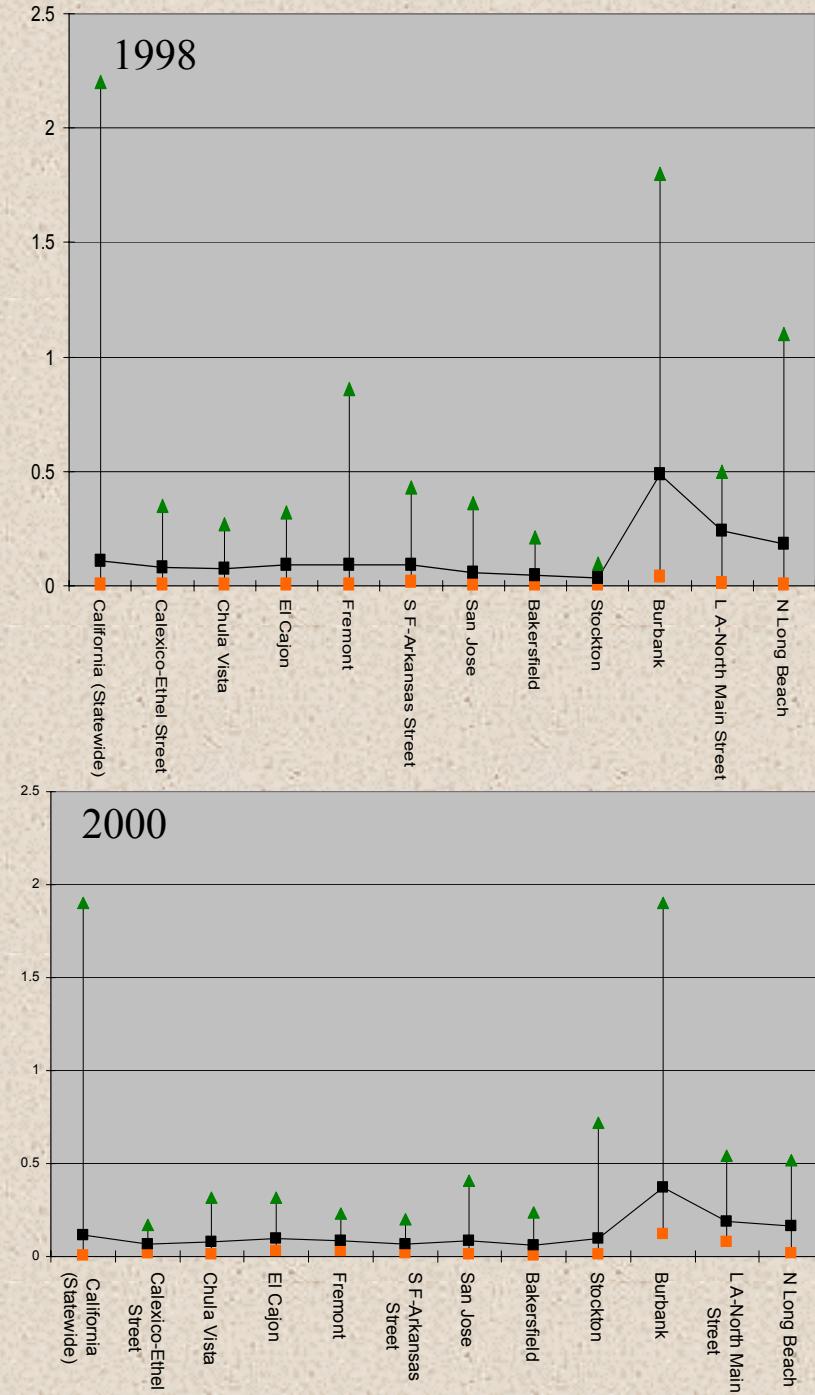
SF Bay Area Seasonal Profile (Monthly Mean) Benzene Concentrations (ppb)



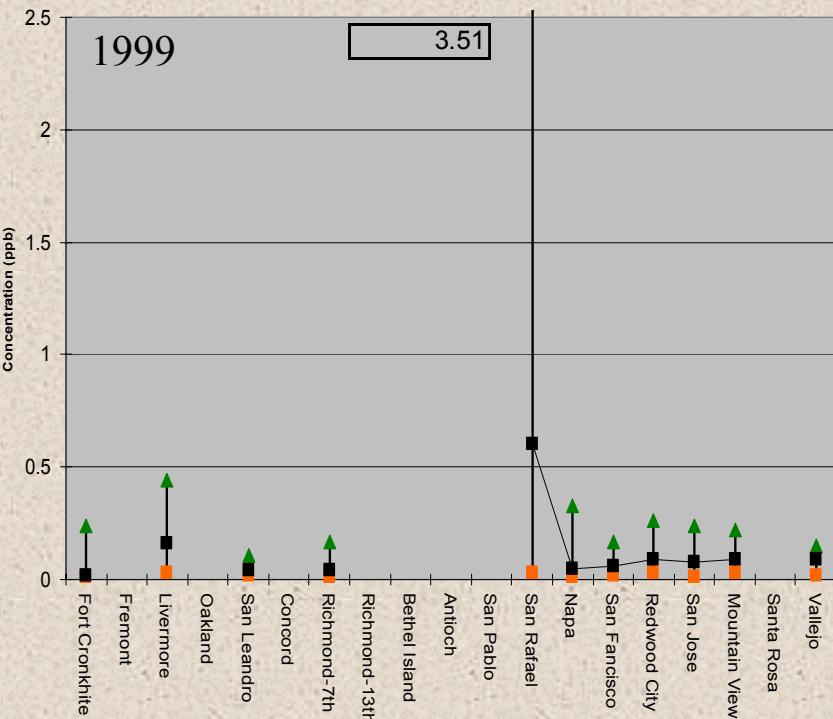
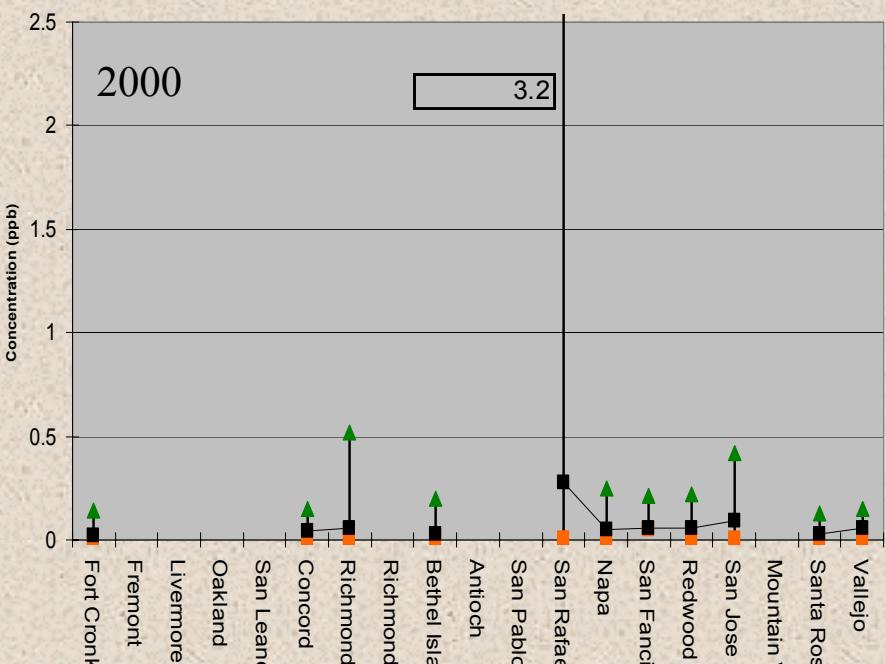
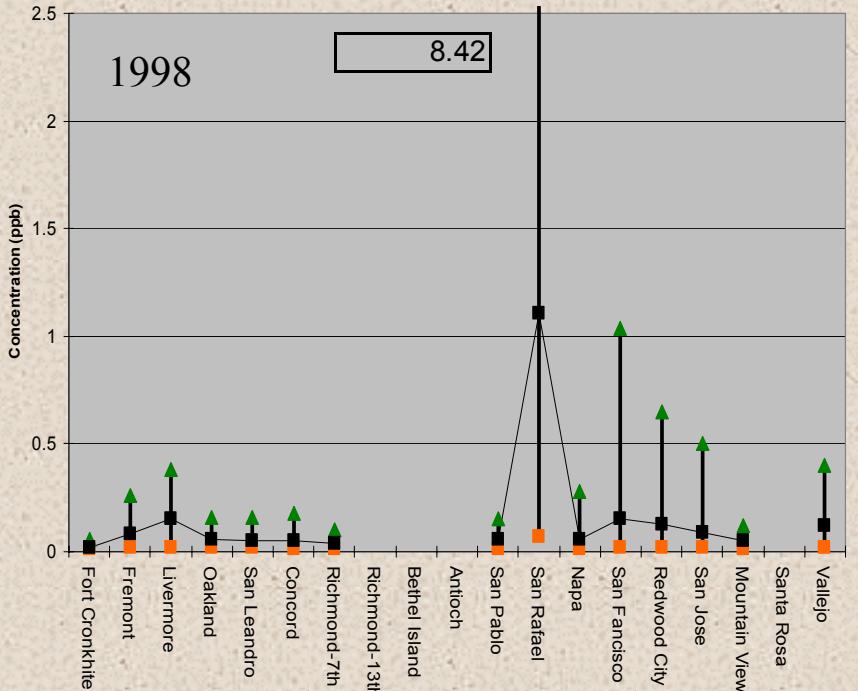
inter-site variation and trends

Perchloroethylene

inter-site variation and trends

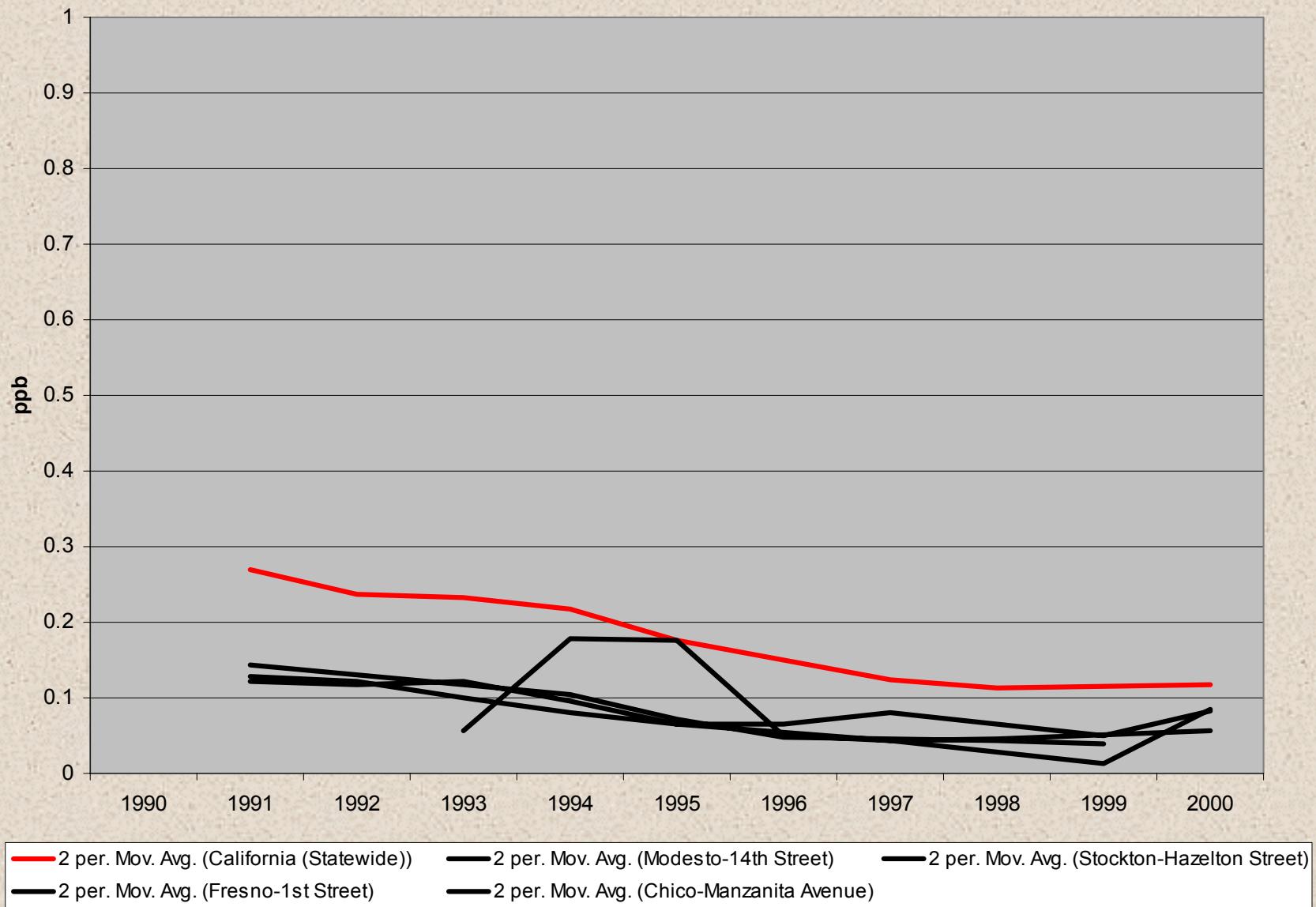


Ambient Perchloroethylene Intersite Variability *Statewide Sites 1998-00* Max/Mean/Min

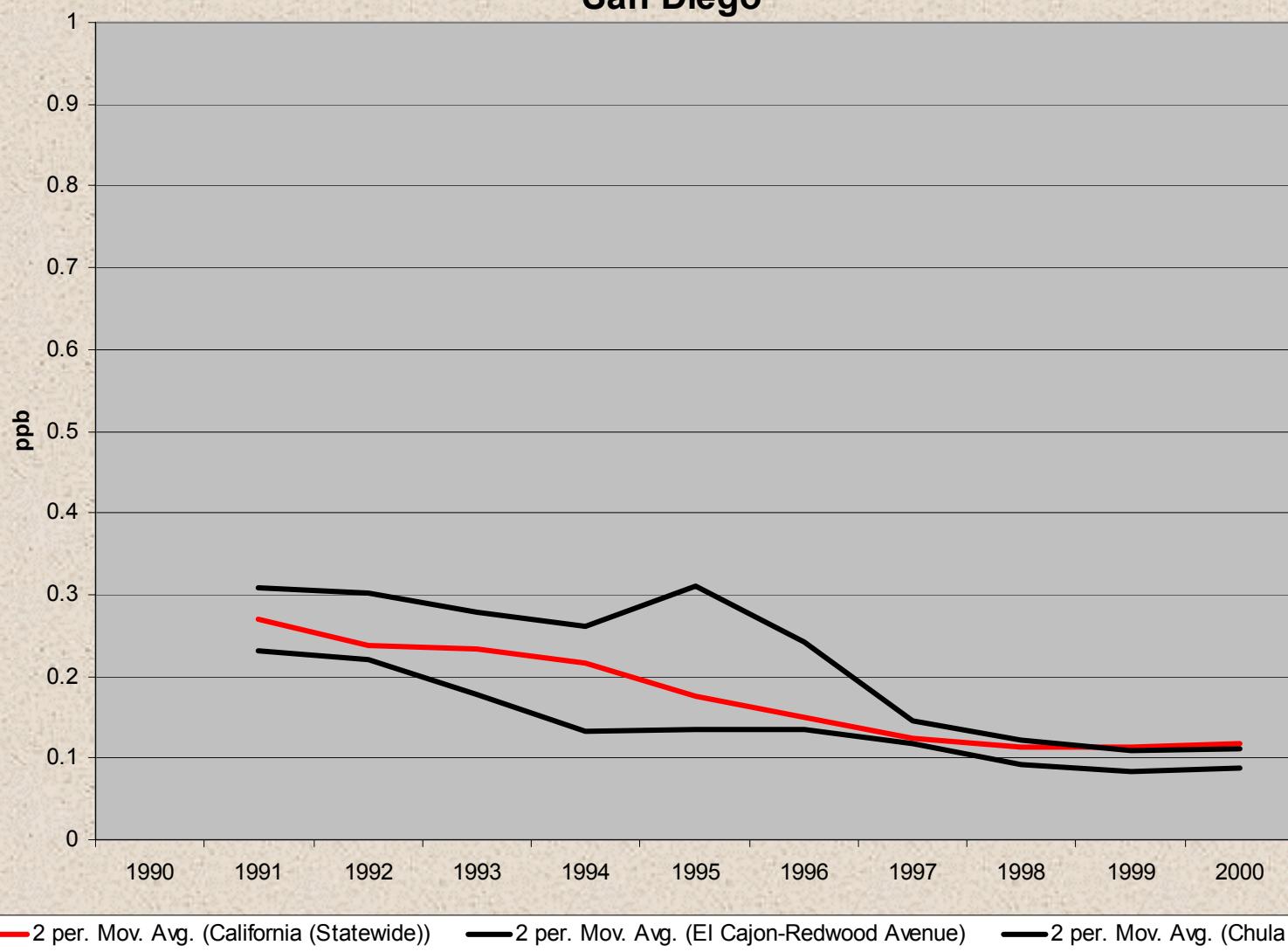


Ambient Perchloroethylene
 Intersite Variability
Regional Sites 1998 and 2000
 Max/Mean/Min
 (SF Bay Area)

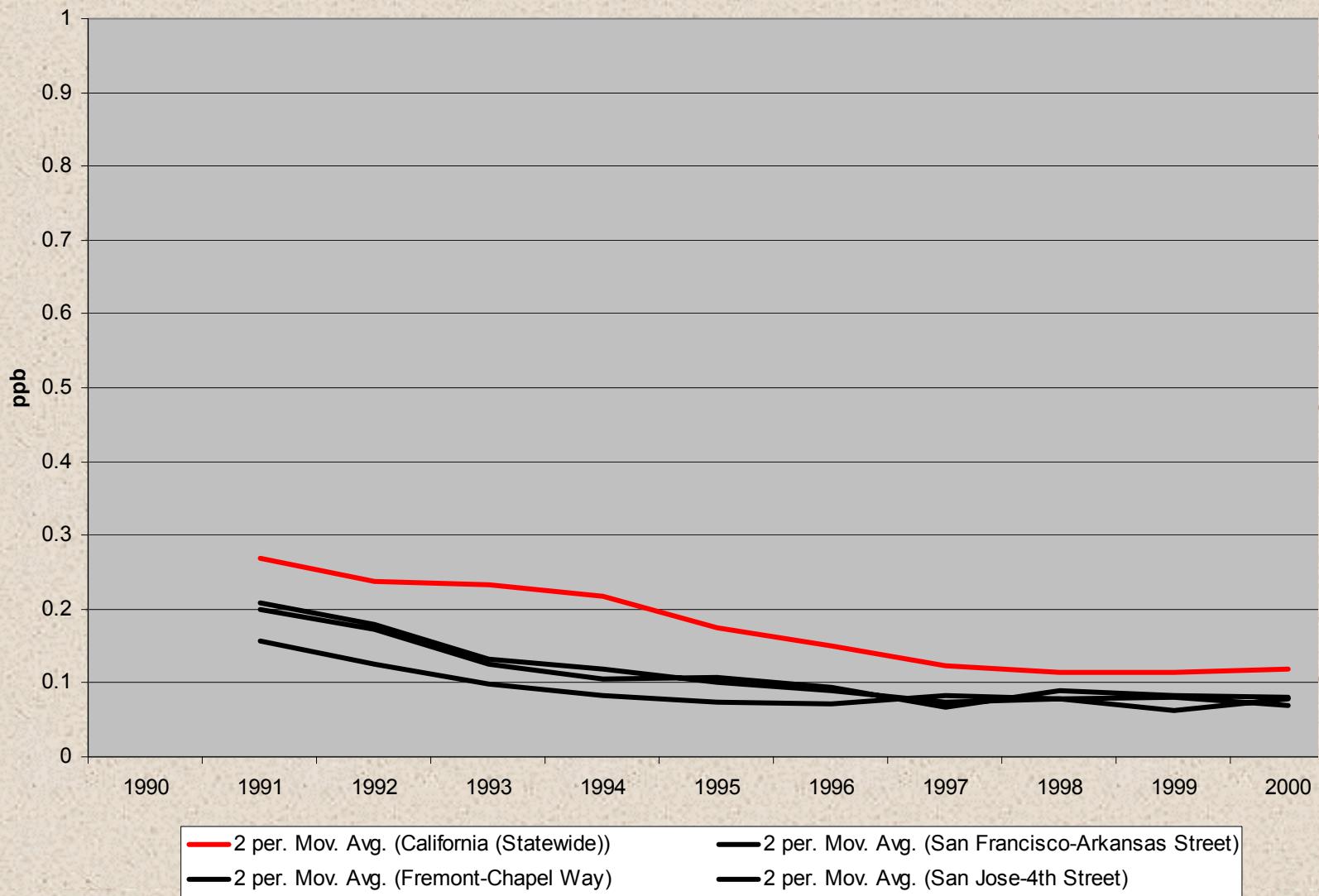
**2 Year Moving Average Perchloroethylene
Central Valley**



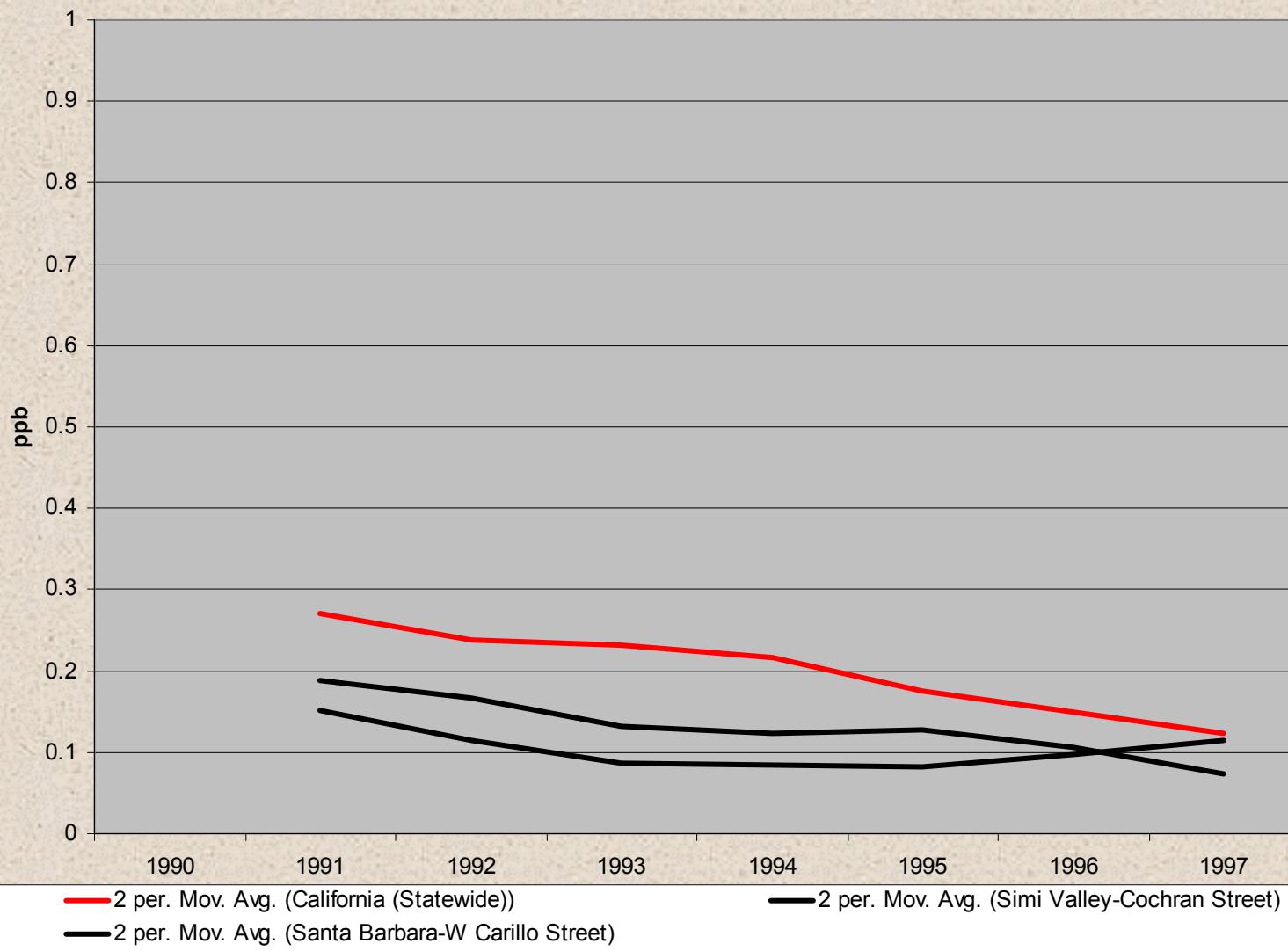
2 Year Moving Average Perchloroethylene San Diego



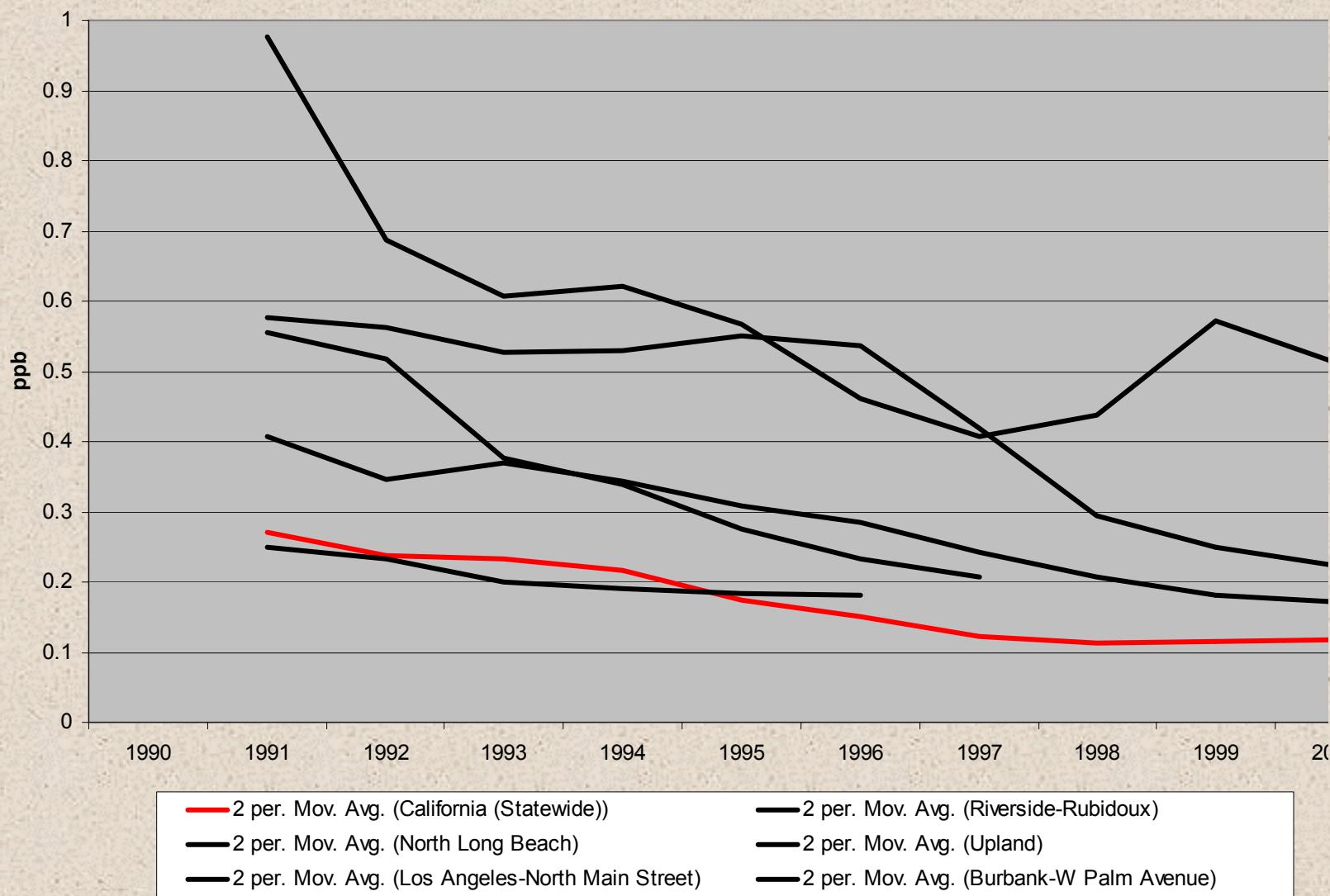
**2 Year Moving Average Perchloroethylene
SF Bay Area**



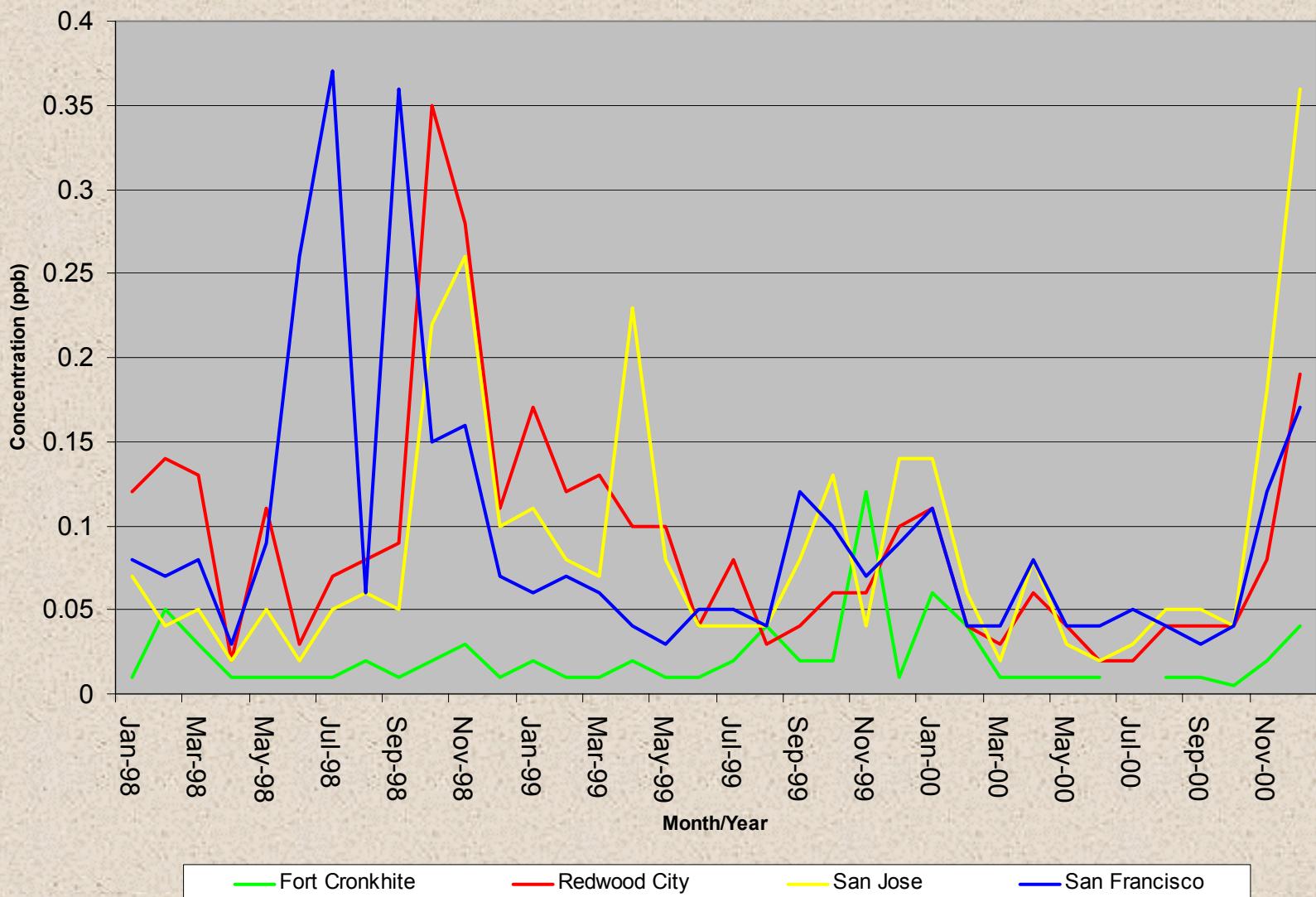
2 Year Moving Average Perchlorethylene South Central Coast



2 Year Moving Average Perchloroethylene South Coast

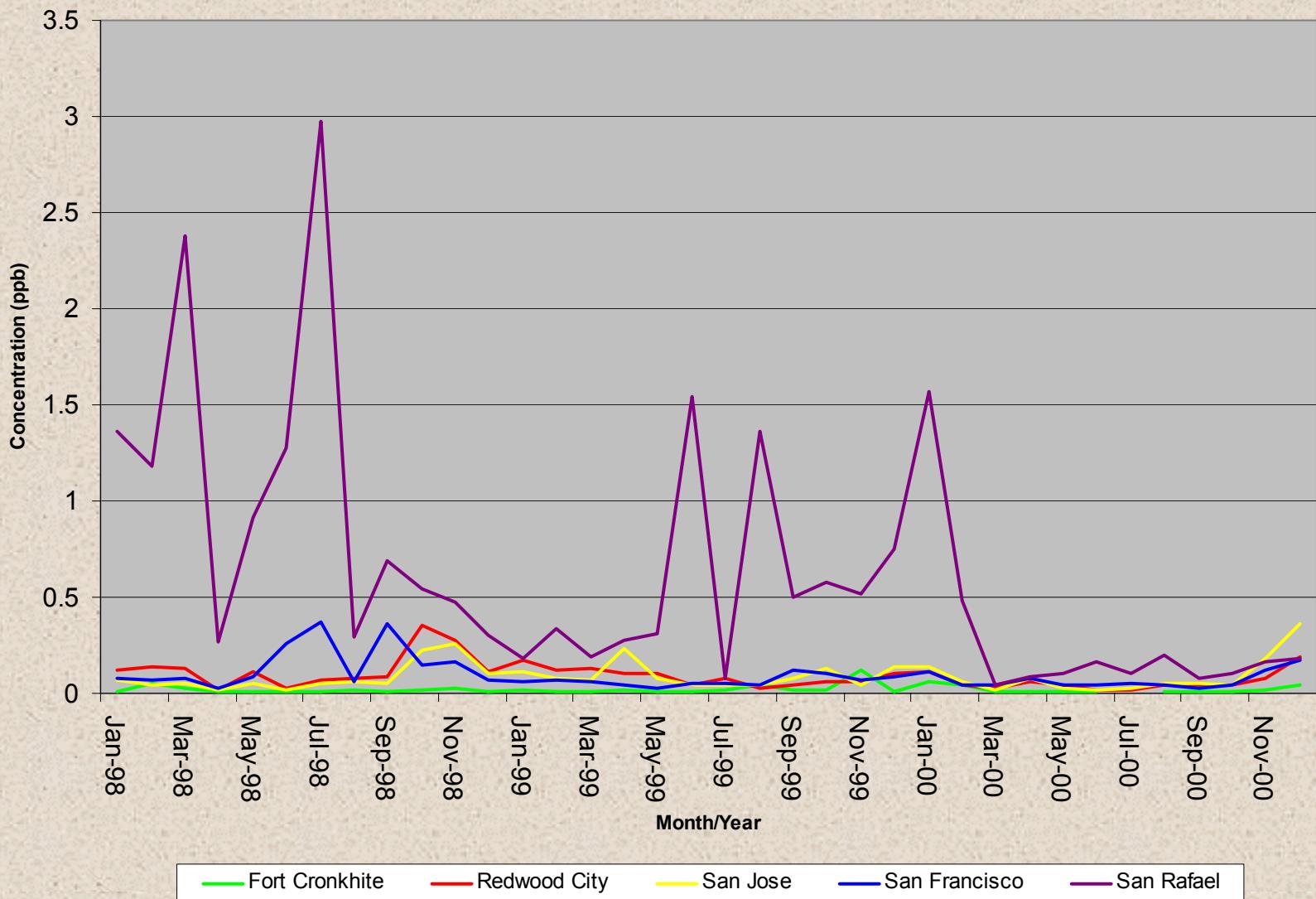


SF Bay Area Seasonal Profile (Monthly Mean)
Perchloroethylene Concentrations (ppb)



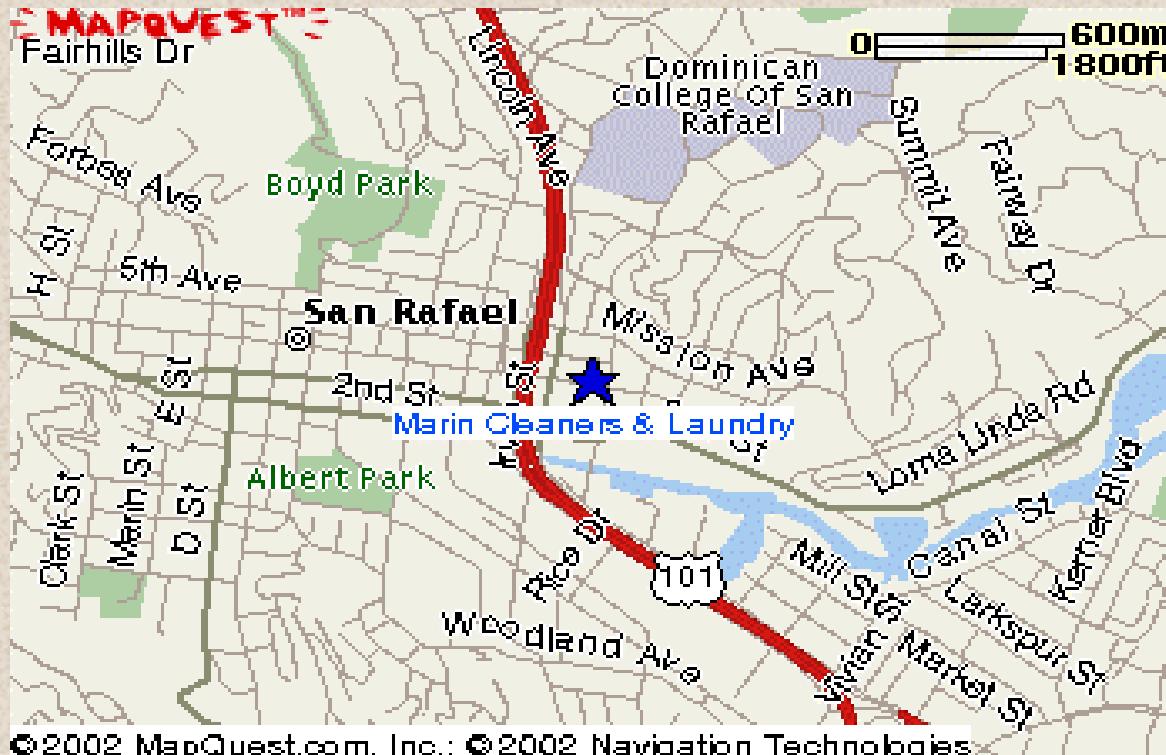
inter-site variation and trends

SF Bay Area Seasonal Profile (Monthly Mean)
Perchloroethylene Concentrations (ppb)

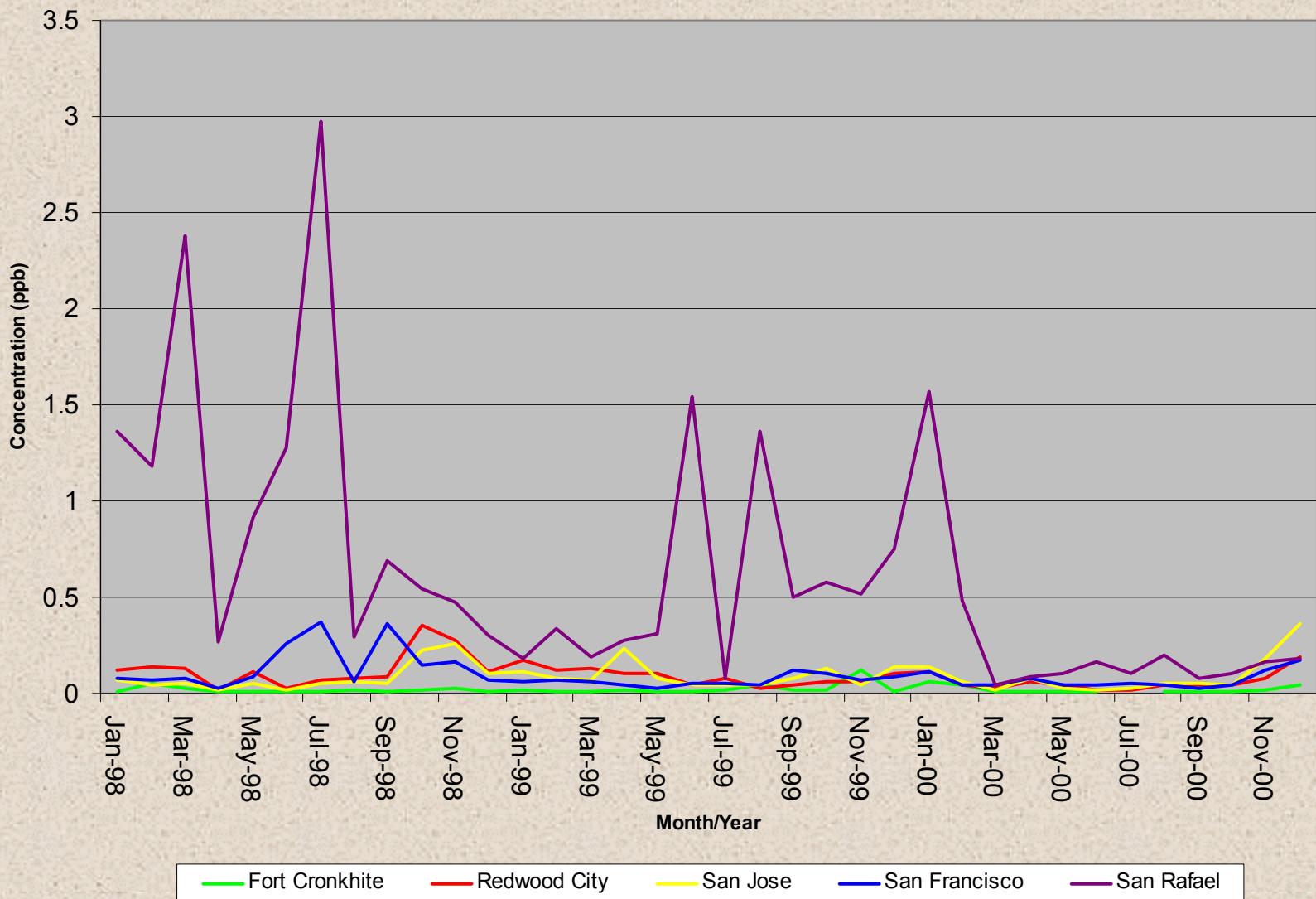


inter-site variation and trends

Perchloroethylene, Dry Cleaners and San Rafael



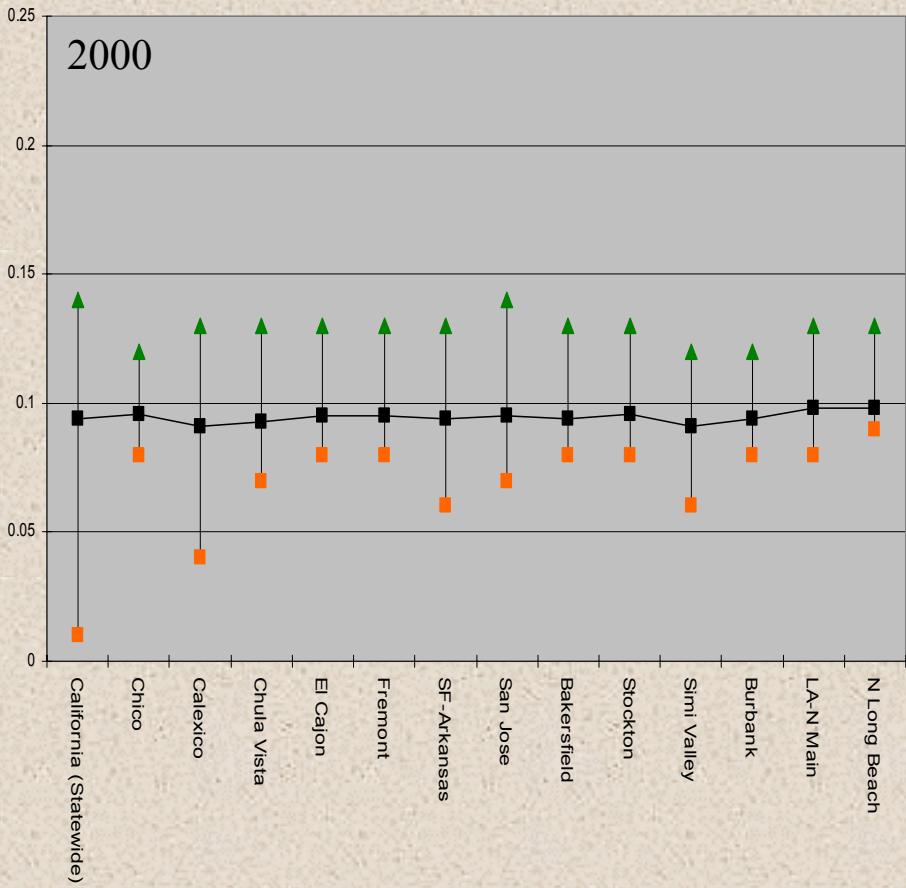
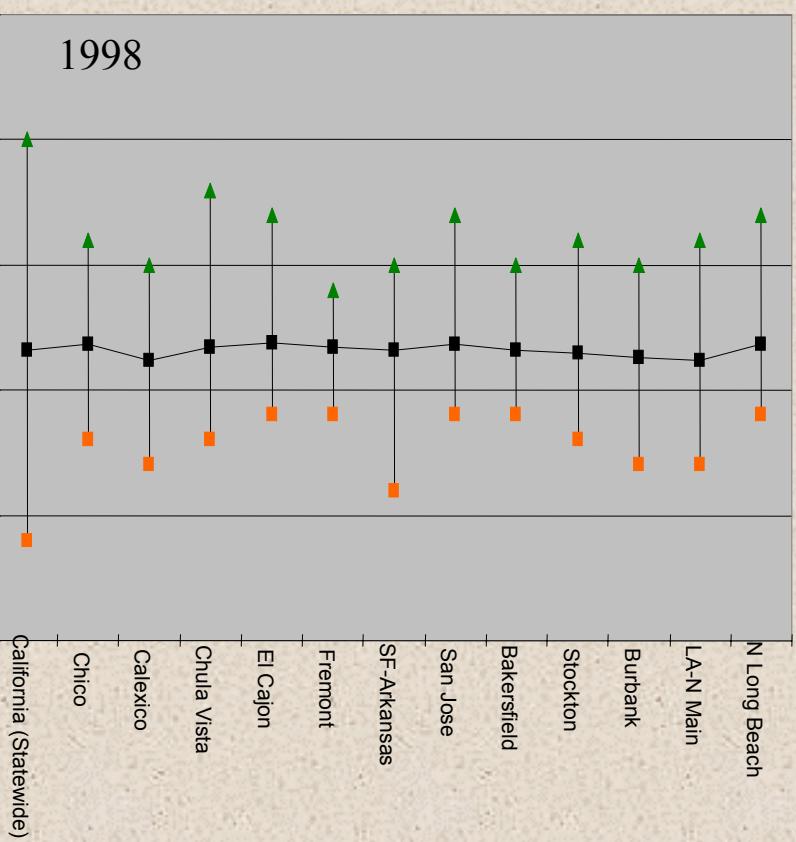
SF Bay Area Seasonal Profile (Monthly Mean)
Perchloroethylene Concentrations (ppb)



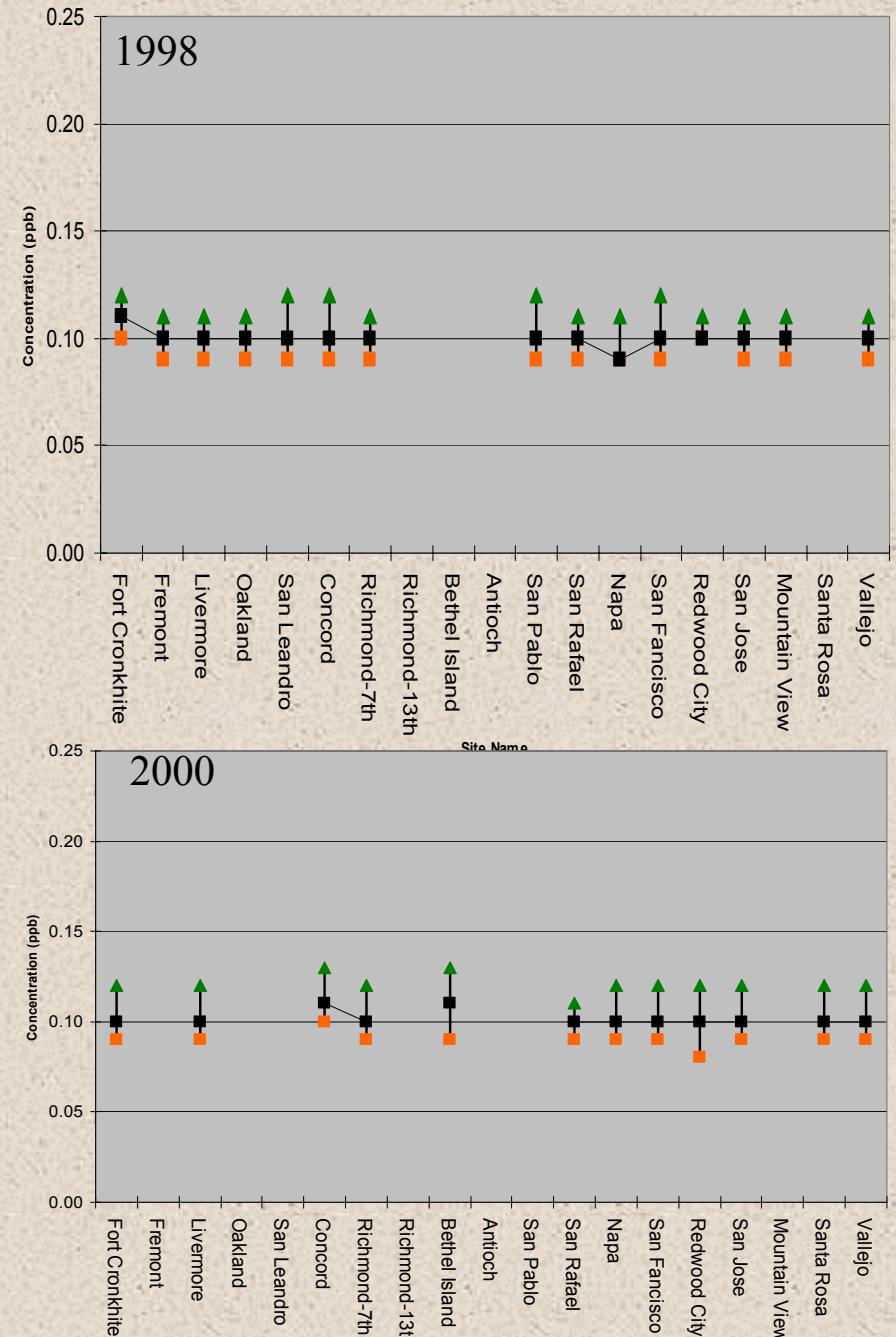
inter-site variation and trends

Carbon Tetrachloride

inter-site variation and trends



Ambient Carbon Tetrachloride Intersite Variability *Statewide Sites 1998 and 2000* Max/Mean/Min



Ambient Carbon Tetrachloride

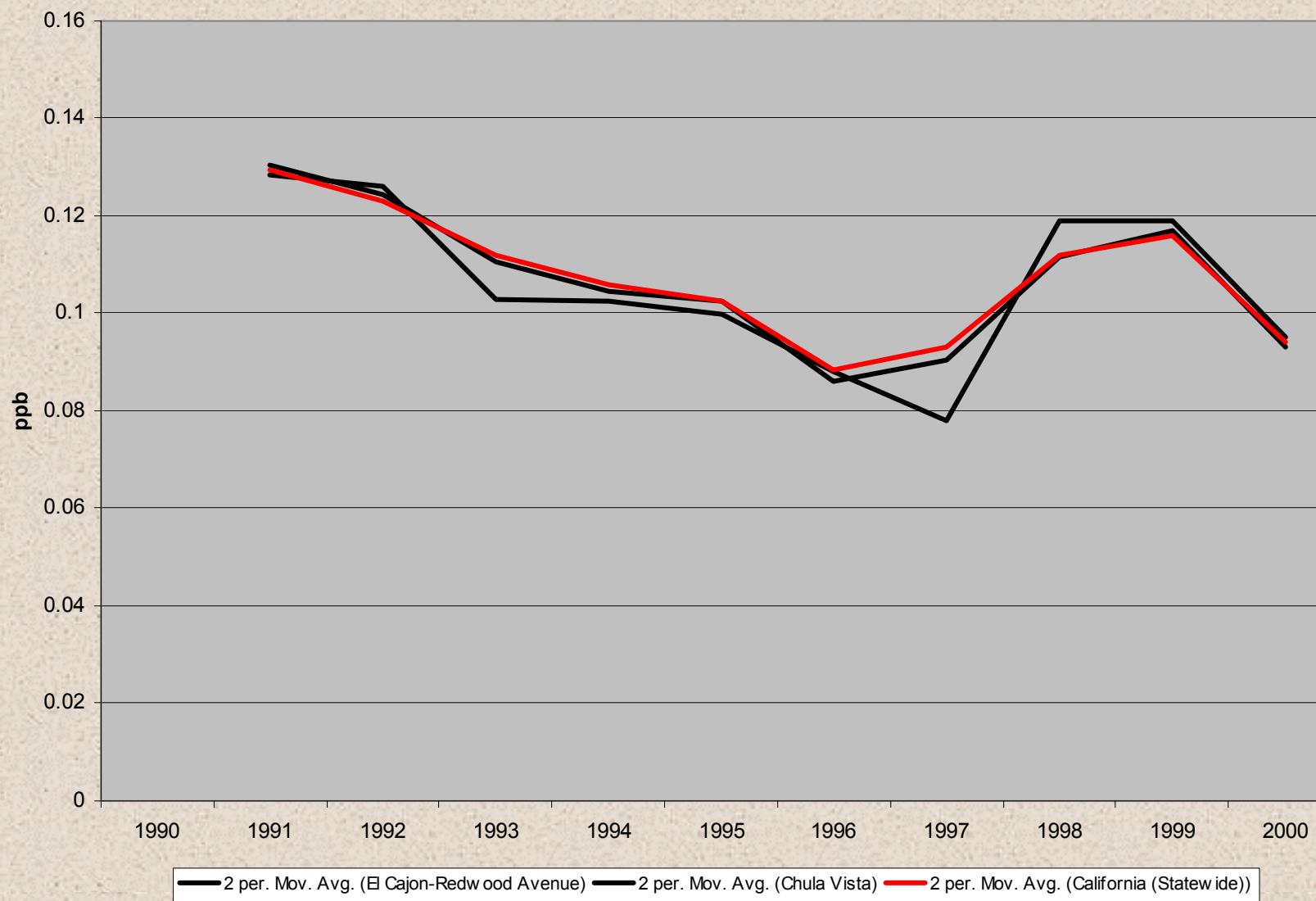
Intersite Variability

Regional Sites 1998 and 2000

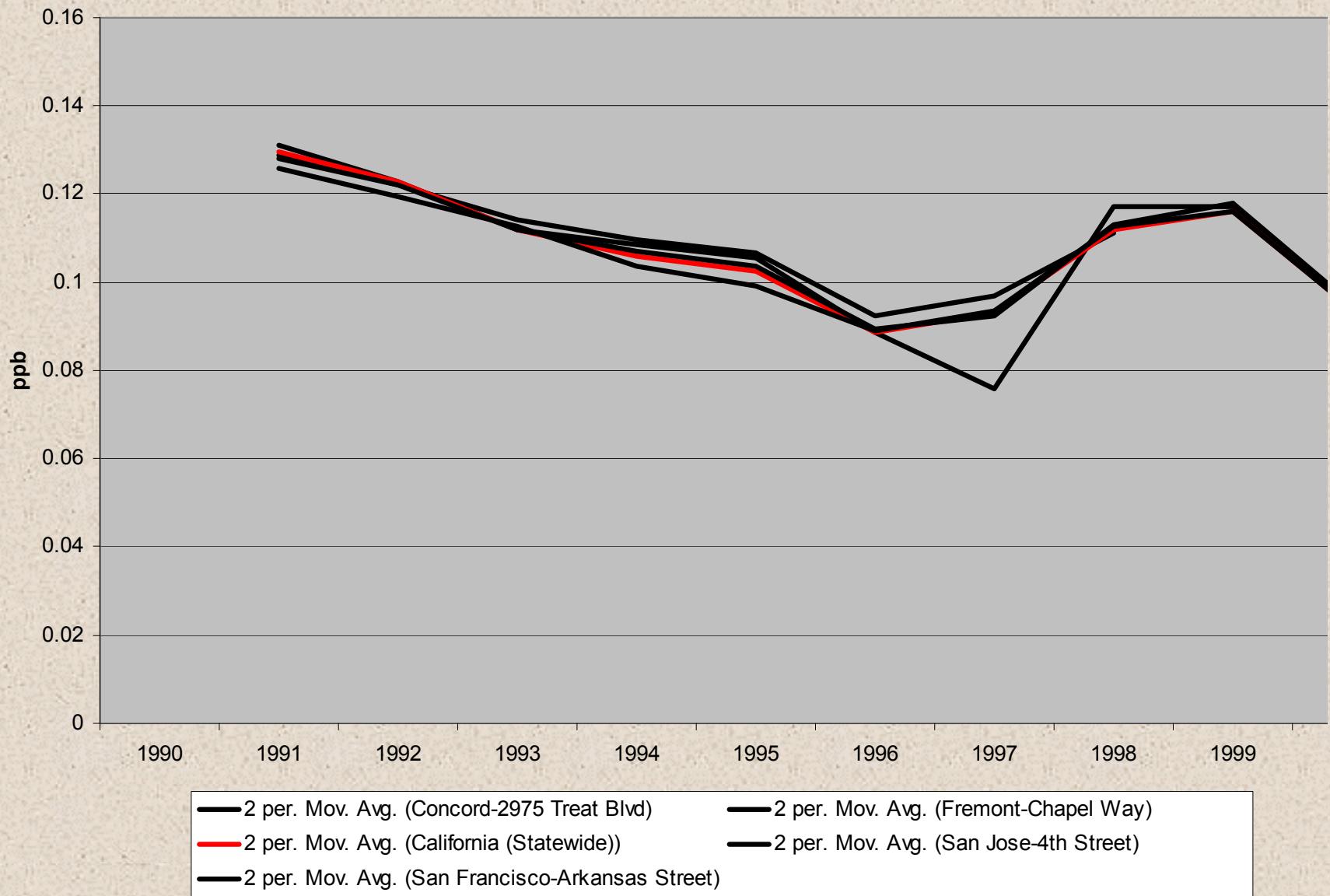
Max/Mean/Min

(SF Bay Area)

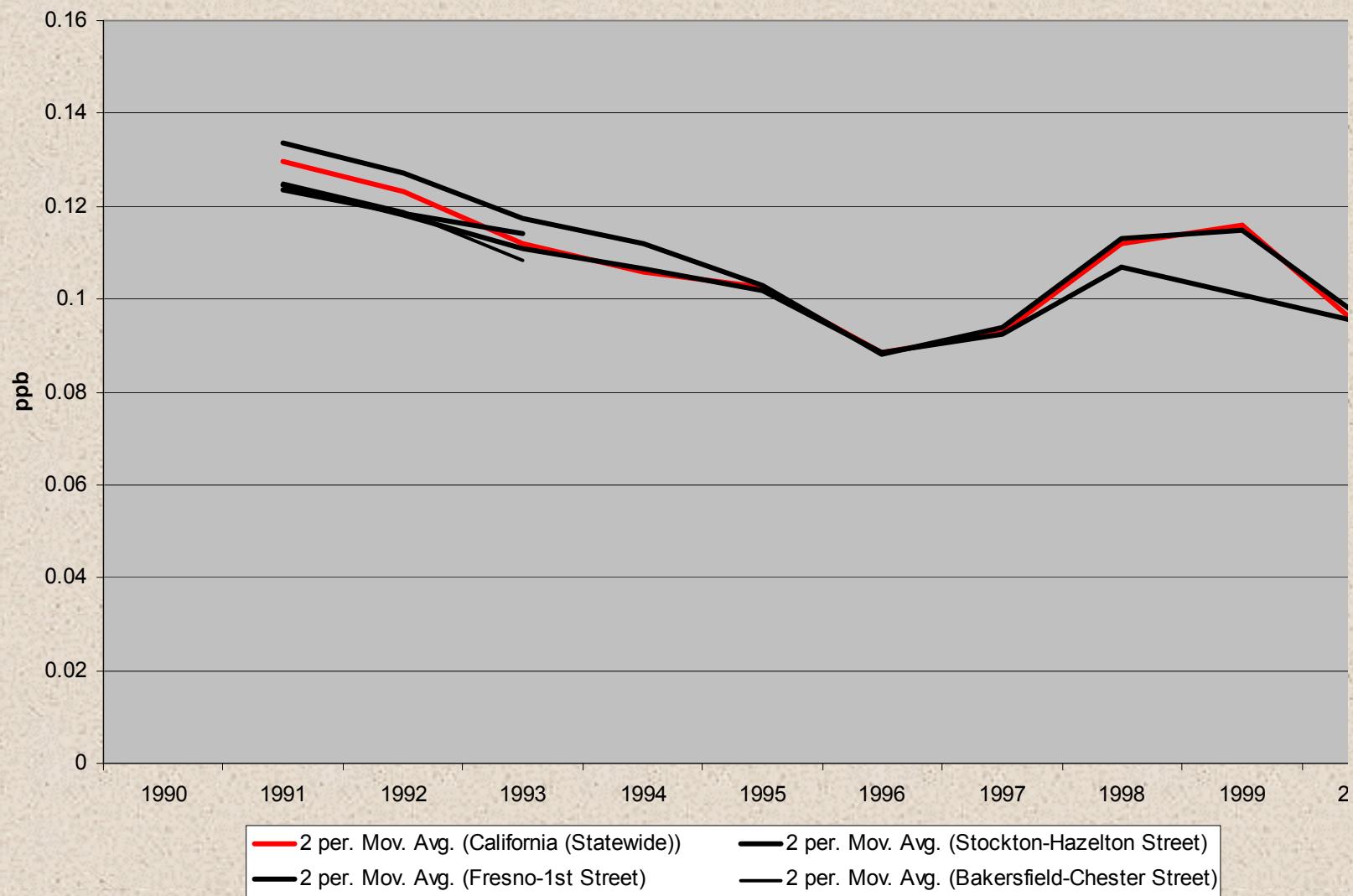
**2 Year Moving Average CCI4
San Diego**



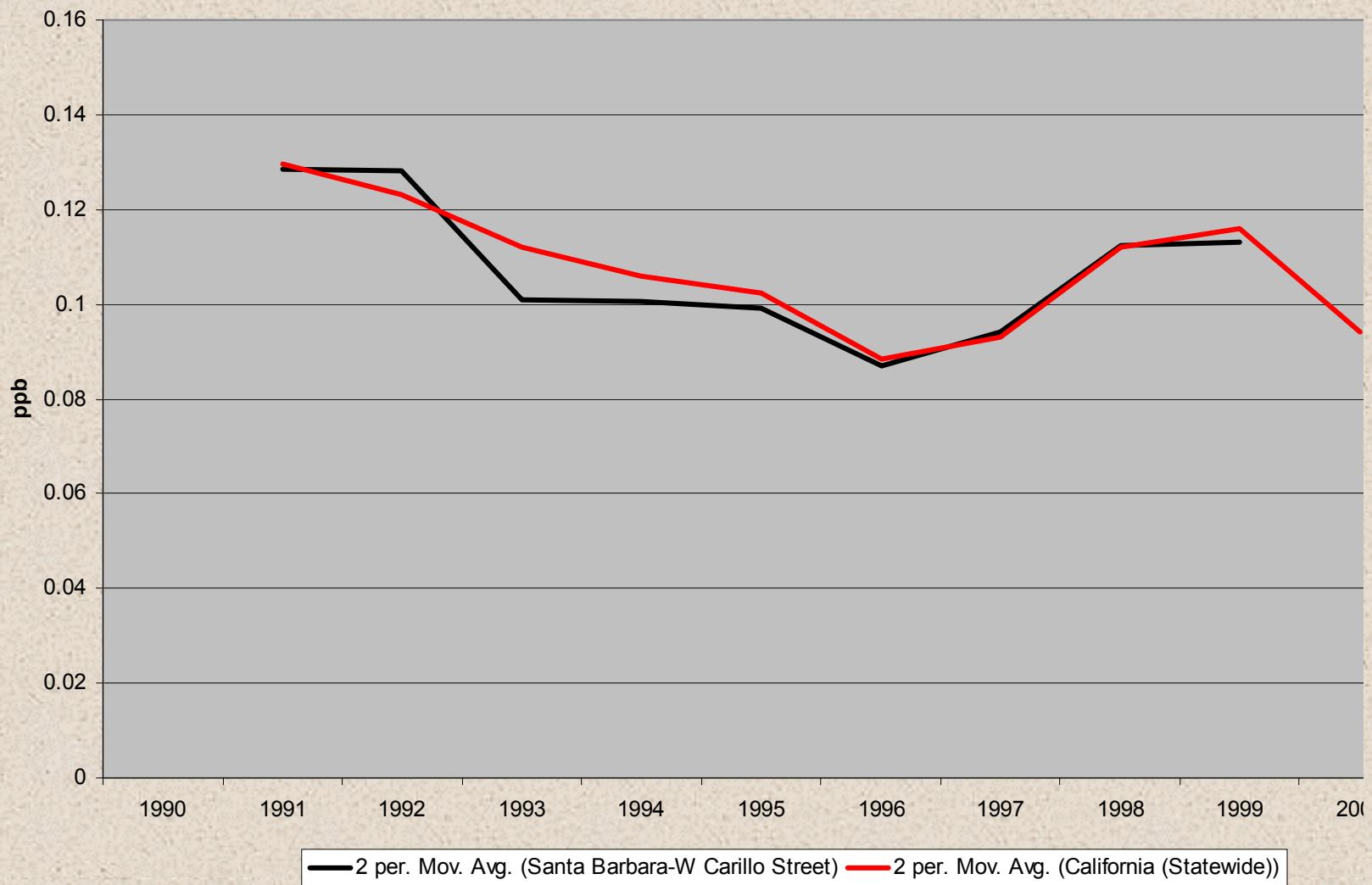
2 Year Moving Average CCI4 Bay Area



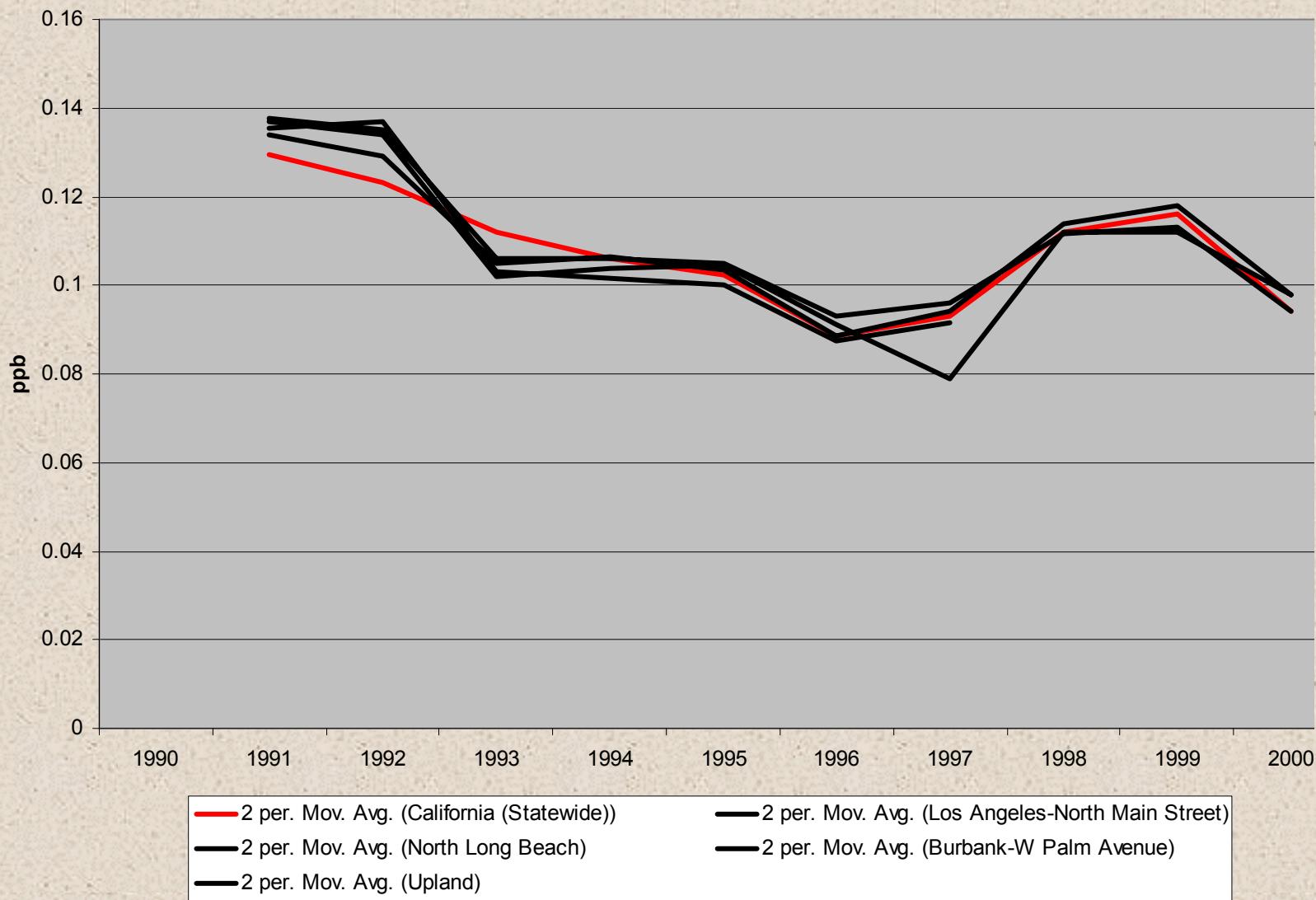
2 Year Moving Average CCI4 Central Valley



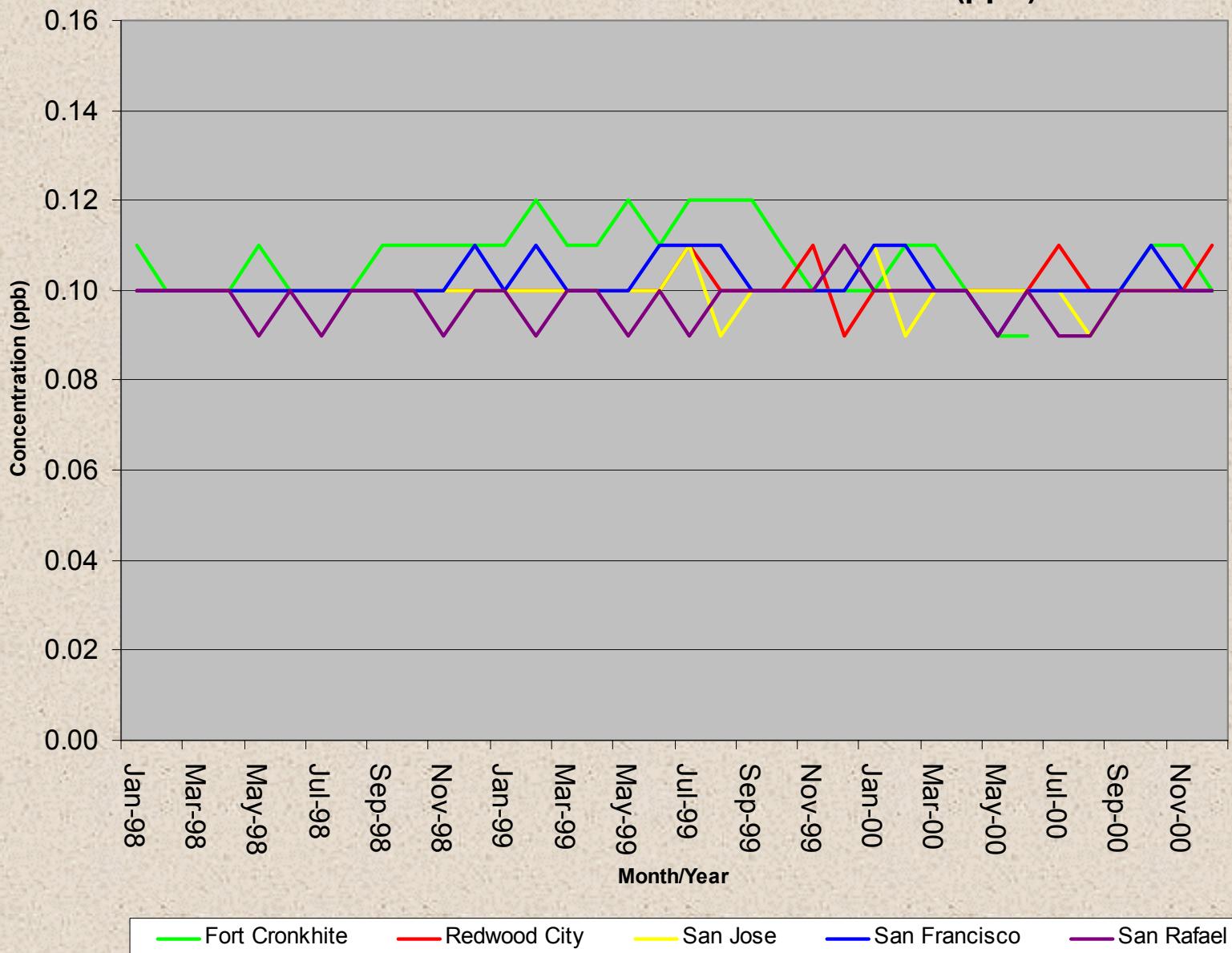
**2 Year Moving Average CCI4
South Central Coast**



**2 Year Moving Average CCI4
South Coast**

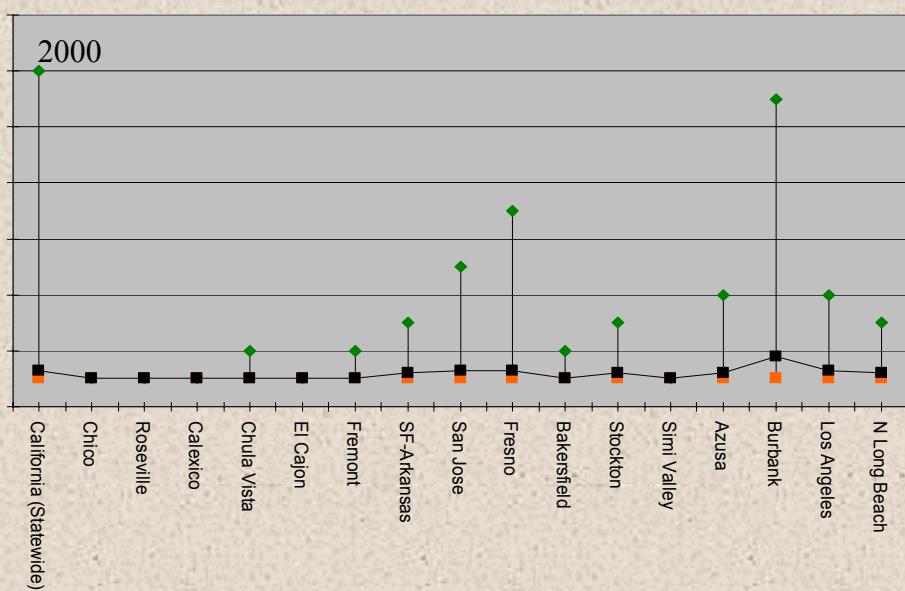
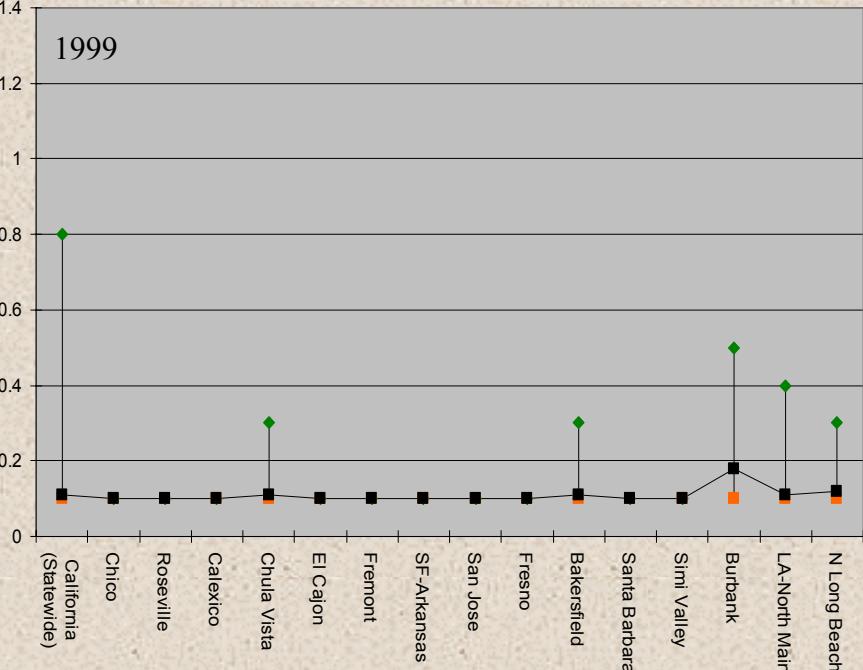
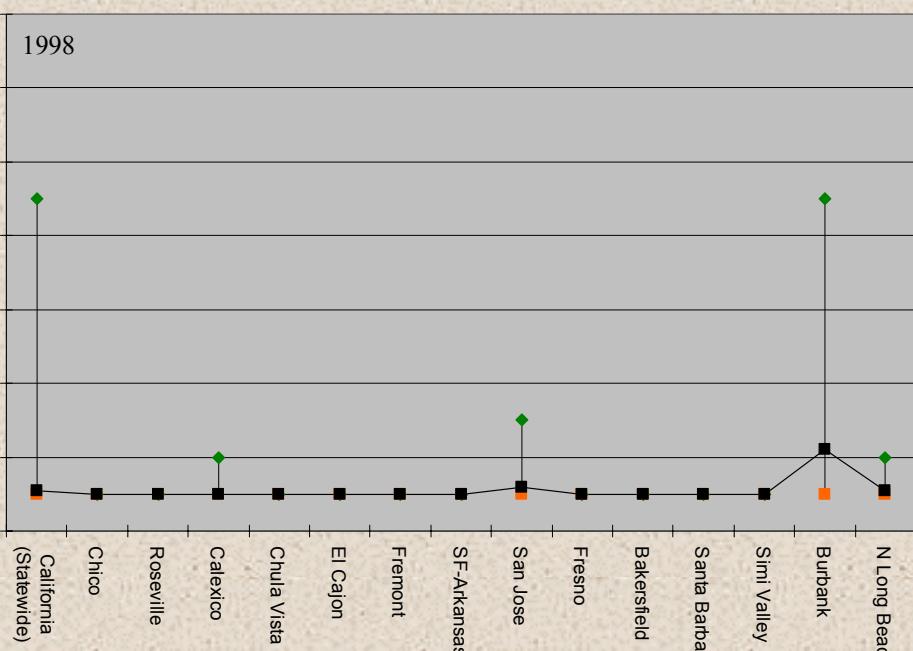


SF Bay Area Seasonal Profile (Monthly Mean) Carbon Tetrachloride Concentrations (ppb)



Hexavalent Chromium

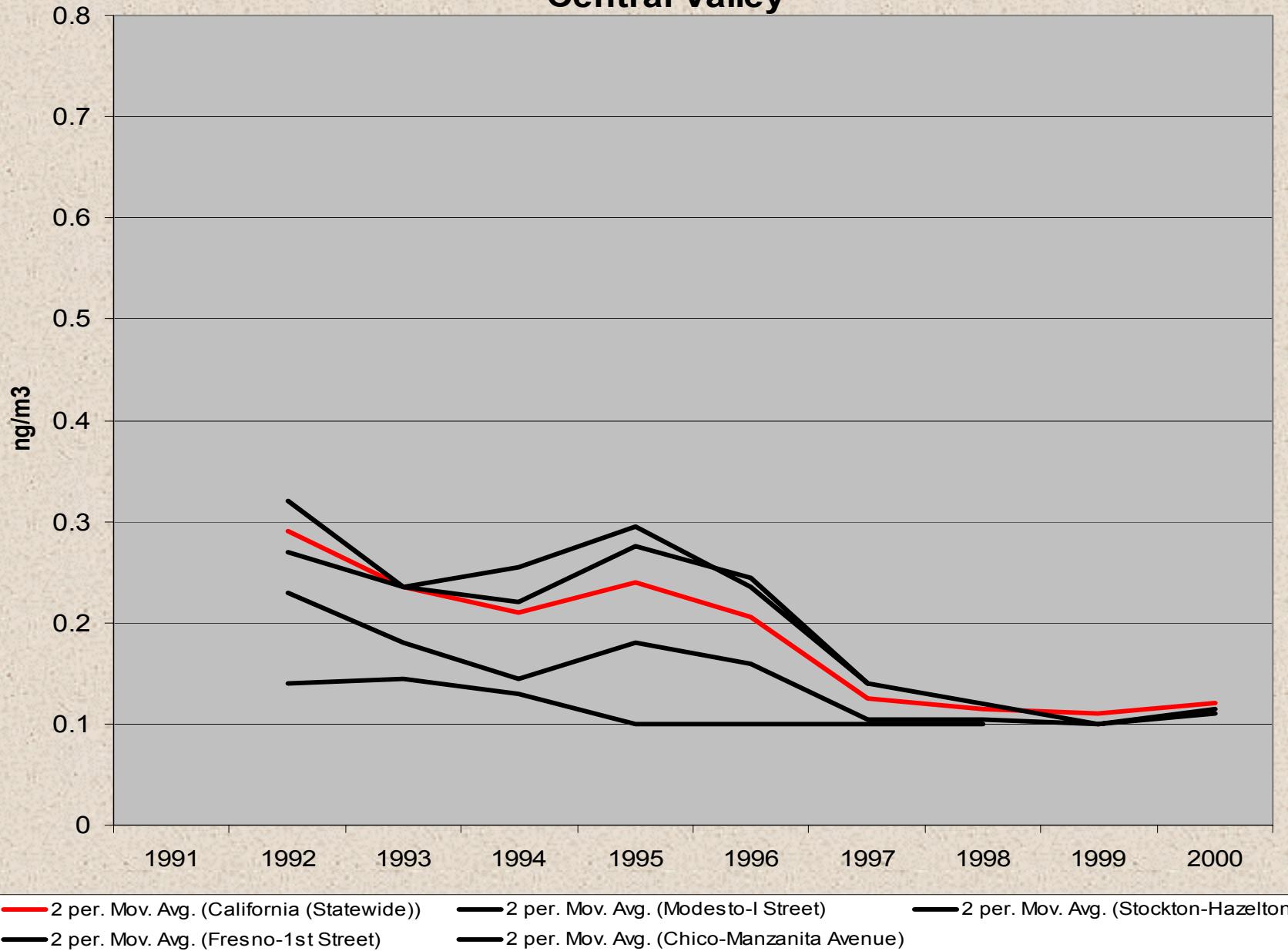
inter-site variation and trends



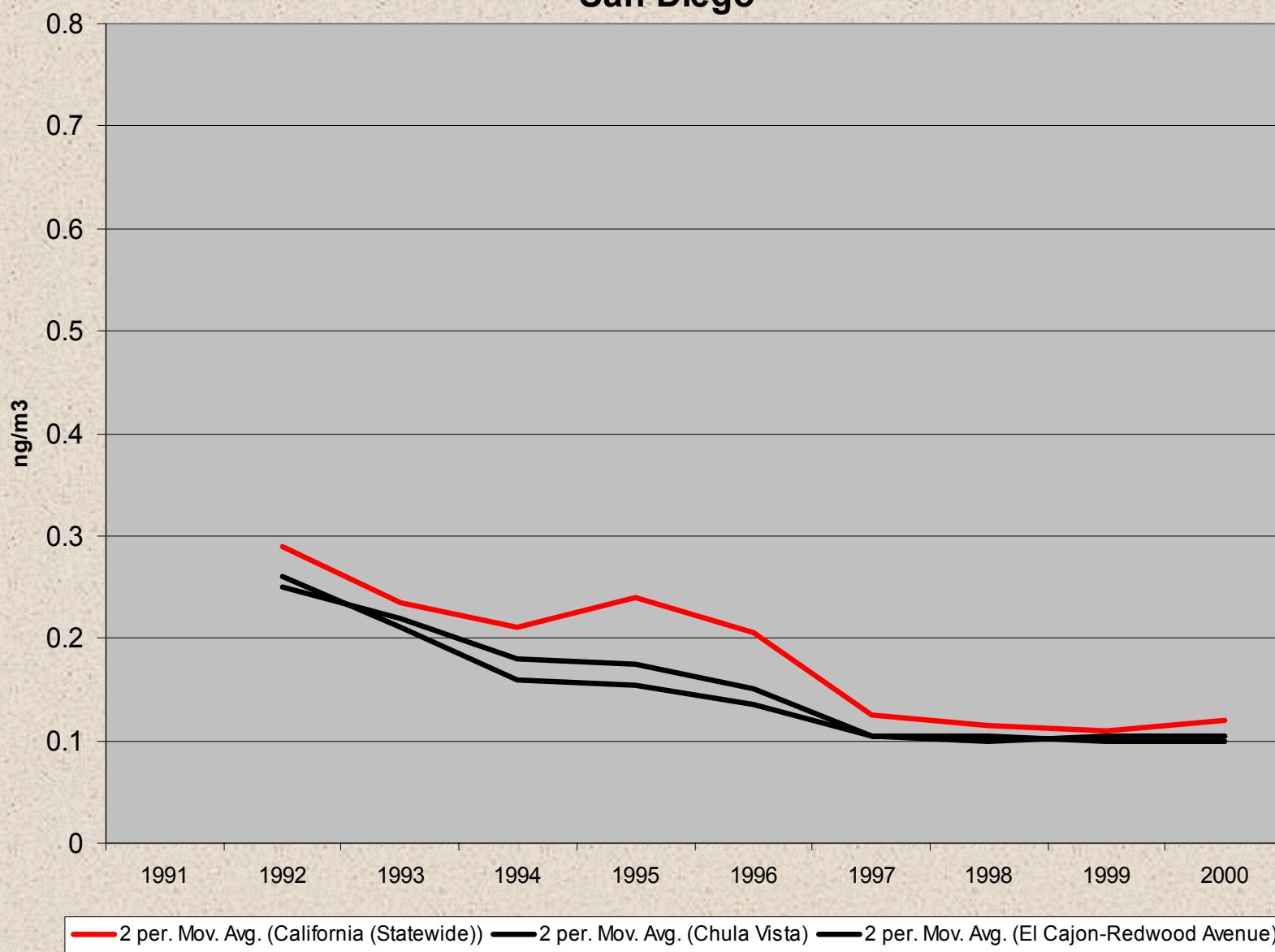
Ambient Hexavalent Chromium Intersite Variability *Statewide Sites 1998-00*

Max/Mean/Min

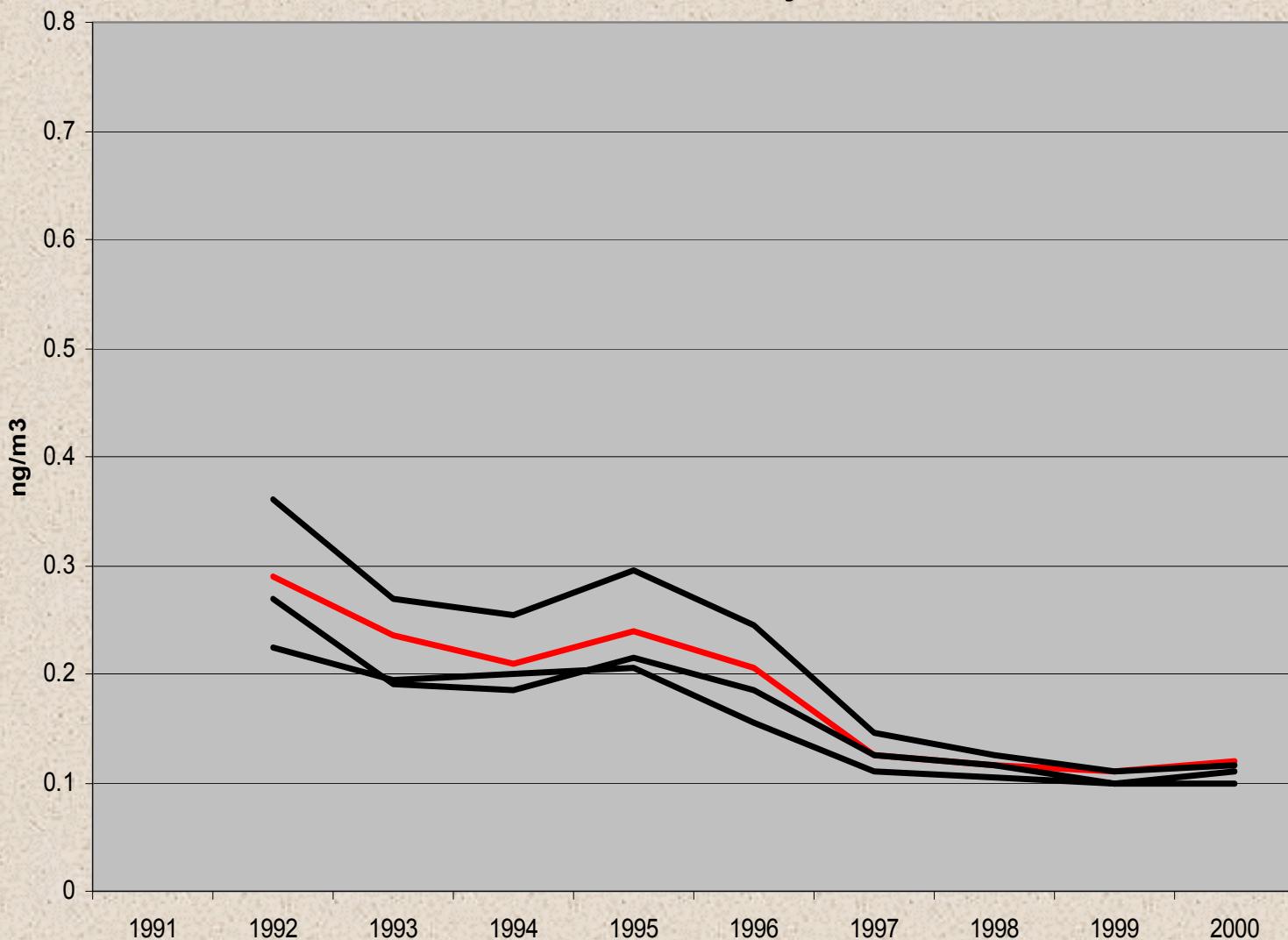
2 Year Moving Average Cr6+ Central Valley



2 Year Moving Average Cr₆₊ San Diego



2 Year Moving Average Cr6+ San Francisco Bay Area



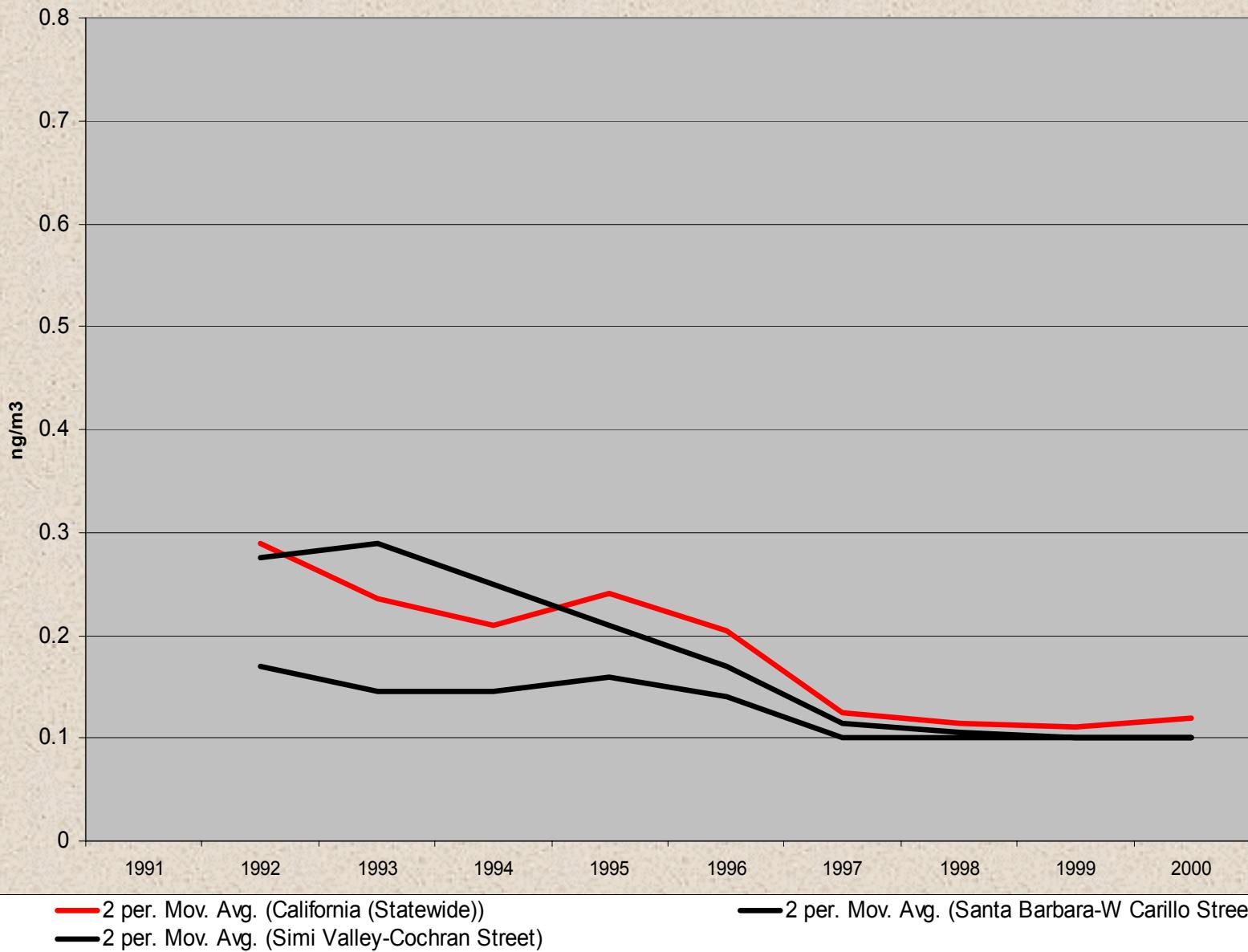
— 2 per. Mov. Avg. (California (Statewide))

— 2 per. Mov. Avg. (San Jose-4th Street)

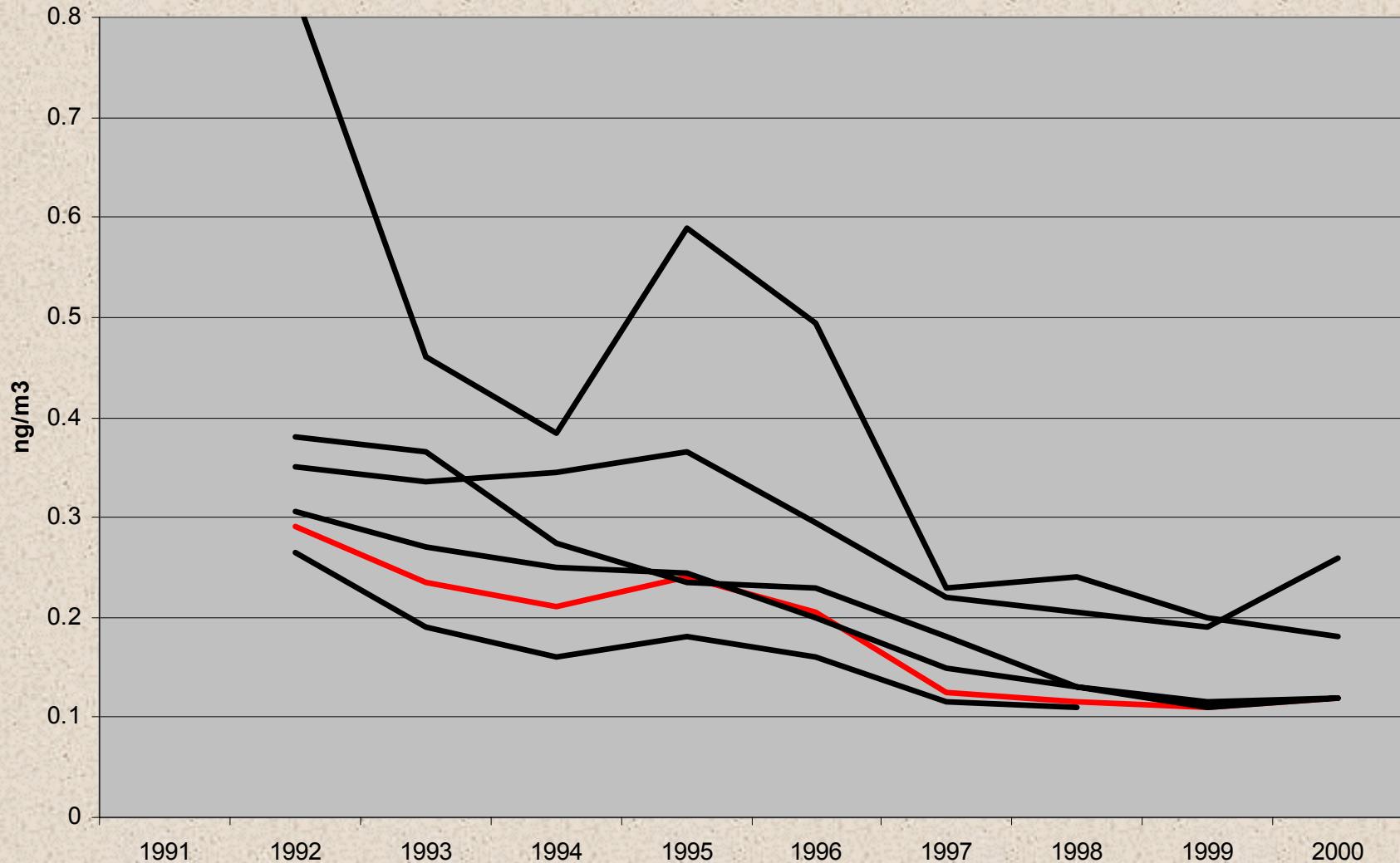
— 2 per. Mov. Avg. (San Francisco-Arkansas Street)

— 2 per. Mov. Avg. (Fremont-Chapel Way)

2 Year Moving Average Cr6+ South Central Coast



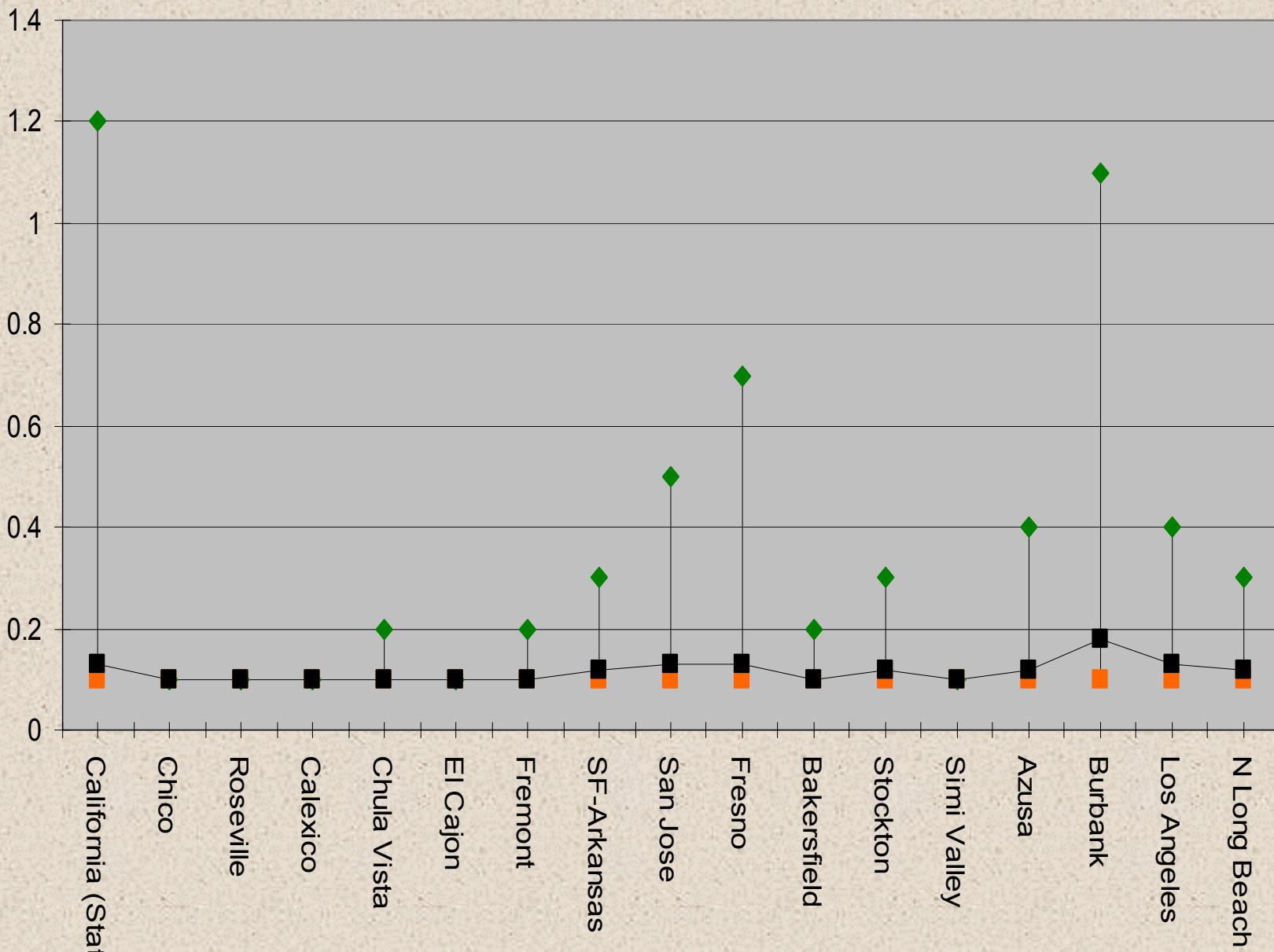
2 Year Moving Average Cr6+ South Coast

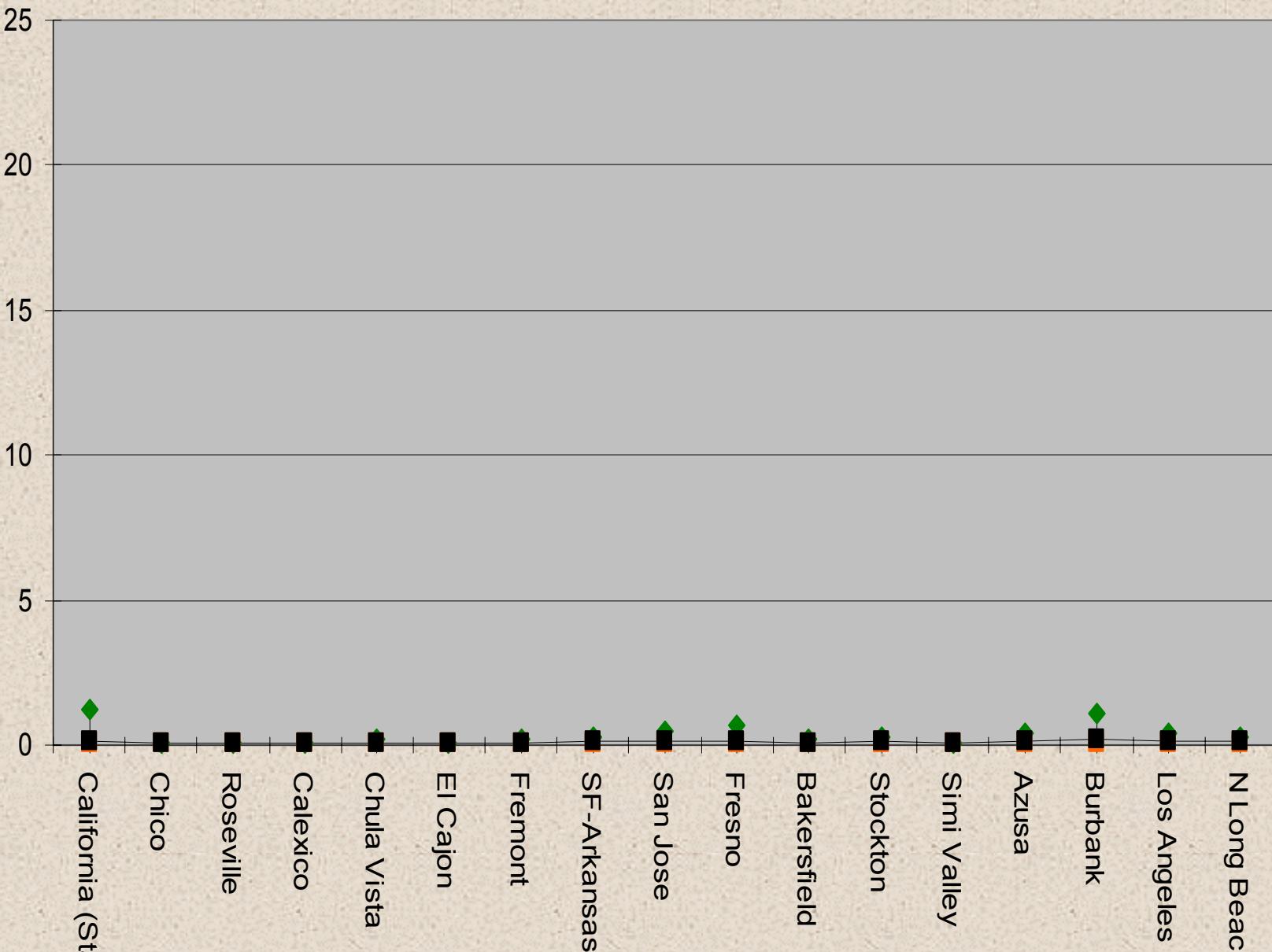


— 2 per. Mov. Avg. (Burbank-W Palm Avenue)
— 2 per. Mov. Avg. (Riverside-Rubidoux)
— 2 per. Mov. Avg. (Los Angeles-North Main Street)

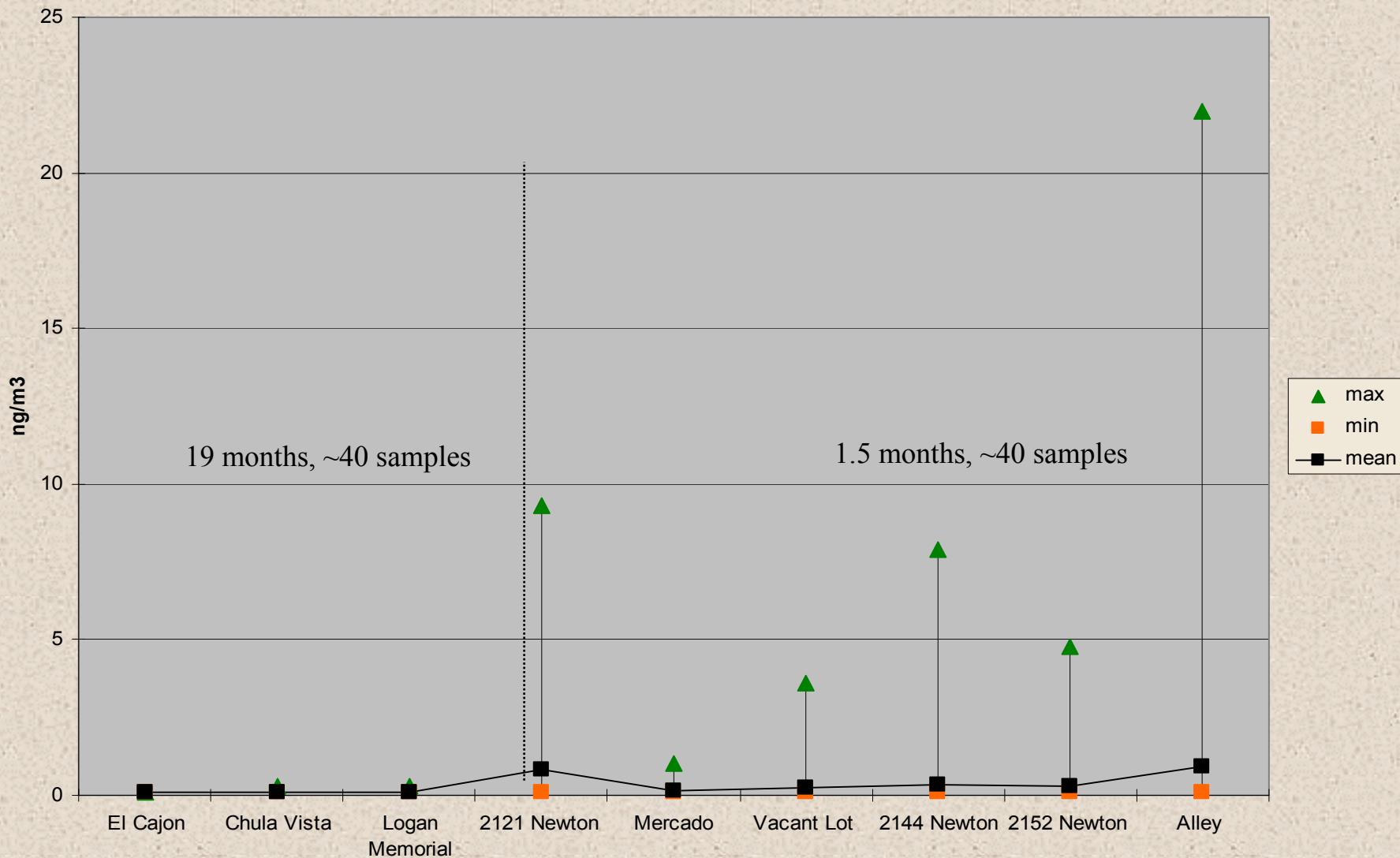
— 2 per. Mov. Avg. (California (Statewide))
— 2 per. Mov. Avg. (North Long Beach)
— 2 per. Mov. Avg. (Upland)

California (Statewide)





San Diego Ambient Hexavalent Chromium

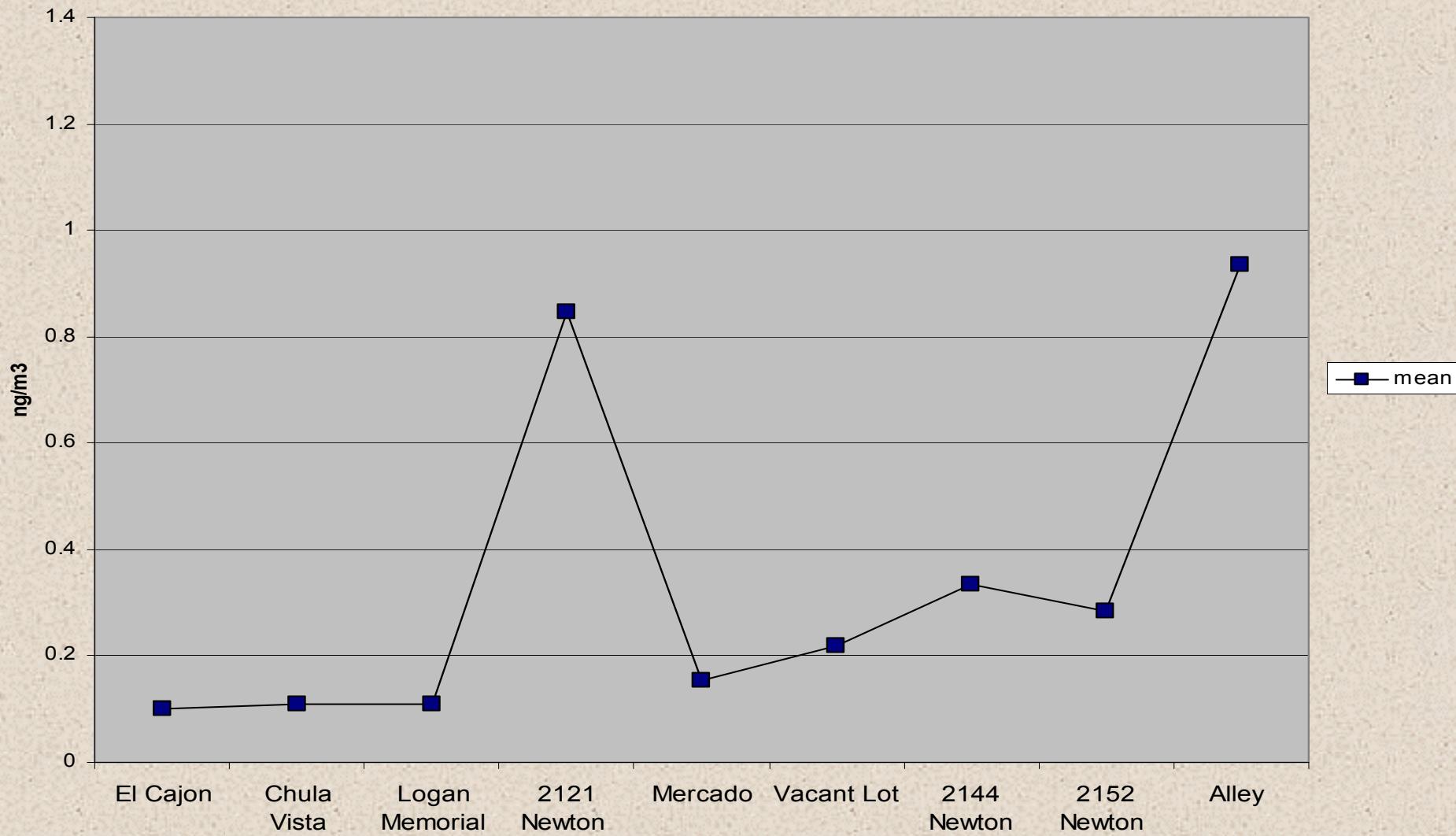


inter-site variation and trends

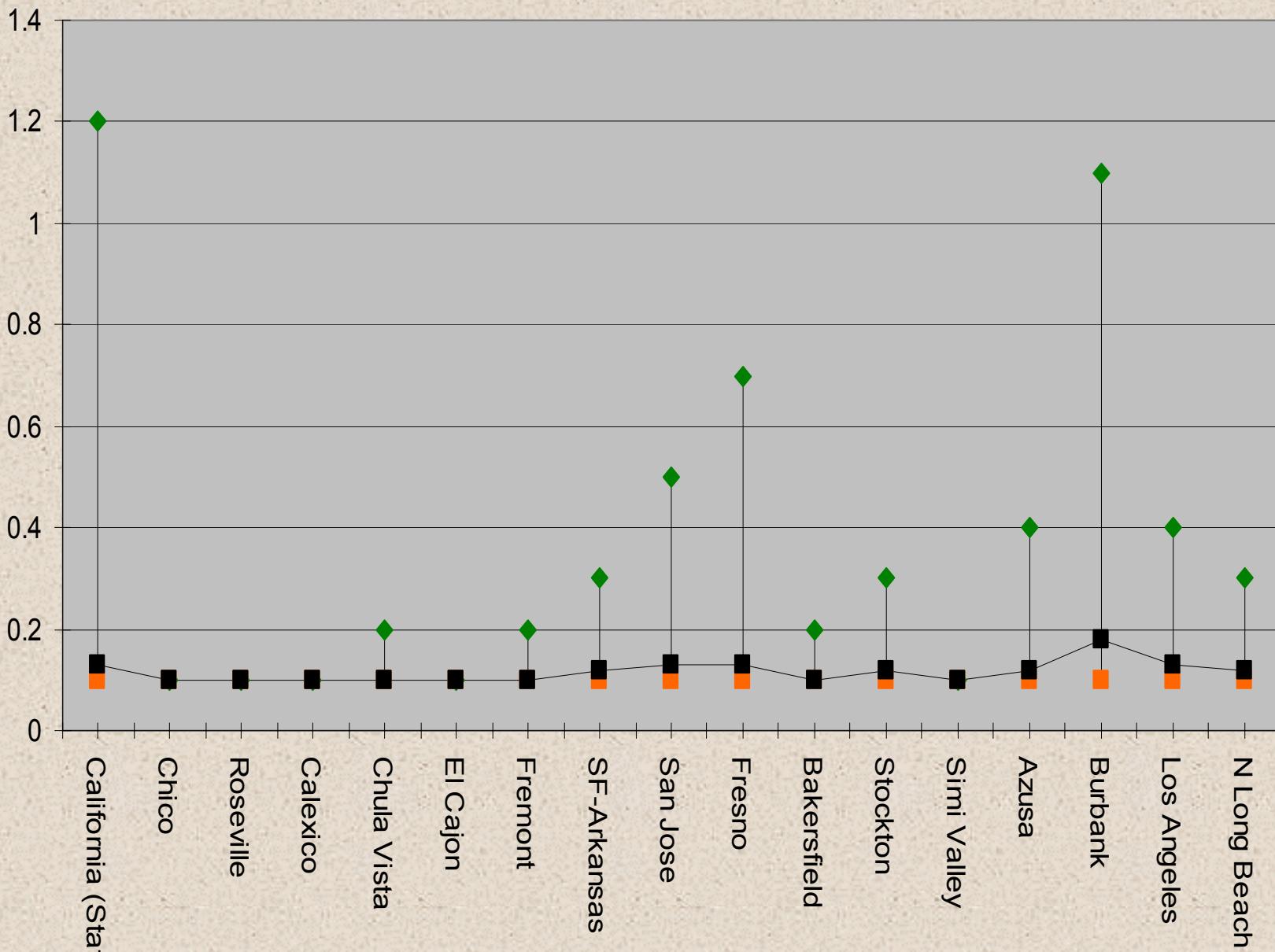
San Diego

Ambient Hexavalent Chromium

Barrio Logan Cr6+ Mean Concentrations



California (Statewide)



Objectives

- Why program established- goals, evolution
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Lessons/Issues

Lessons/Issues

- Regional monitoring can be a reasonable and cost effective means of assessing exposure of motor vehicle and similarly prevalent pollutants
- Regional monitoring has supported identification and adoption of control measures of motor vehicles, fuels, point, and area sources (e.g. CBG, perchloroethylene and hexavalent chromium)

Lessons/Issues

- **Regional monitoring adequately addressed changes in air quality levels due to fuel switching and other motor vehicle controls**
- **Regional monitoring can also detect well-mixed cumulative emissions of many small sources.**

Lessons/Issues



- Regional monitors capture one aspect of point source monitoring, yet may overlook sub-regional populations exposed to high risk pollutants, and overlook the need for additional source controls.

Lessons/Issues

- A dense air monitoring network in a region can provide useful information on exposure due to neighborhood point sources.
- There will be trade offs between regional and neighborhood monitoring resources. Sampling frequency, number of sites, and duration need to be carefully balanced to achieve objectives of both.

Lessons/Issues



- Neighborhood monitoring provides a distinct view of disproportionate risk that often exceeds that expressed by regional monitors.
- Neighborhood monitoring is particularly effective when sources are clustered and pollutants are high risk compounds.



Lessons/Issues

- Neighborhood monitoring is dynamic. Interest is often greater, objectives likely to evolve.
- Point source monitoring will be comprehensive and time consuming, e.g. number of sites and number of samplers, changing objectives, dealing with community, etc.

Lessons/Issues



- Near source modeling has a role in assisting neighborhood monitoring design.



- Neighborhood modeling places greater demand on need for local facility-by-facility emissions information.

Lessons/Issues

-  Neighborhood monitoring should have a point of instigation, i.e. a community concern. A source category or cumulative impact of sources in neighborhood must be identified.

Lessons/Issues

- Local findings from neighborhood monitoring projects need to be leveraged to a larger result to help justify cost incumbent in this type of effort.
- Findings from neighborhood monitoring are transferable and can benefit other communities with similar problems.

Lessons/Issues



- Neighborhood monitoring will be the basis for strengthening emissions controls from point sources.